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KELSEY CREEK
MINERAL RESERVE

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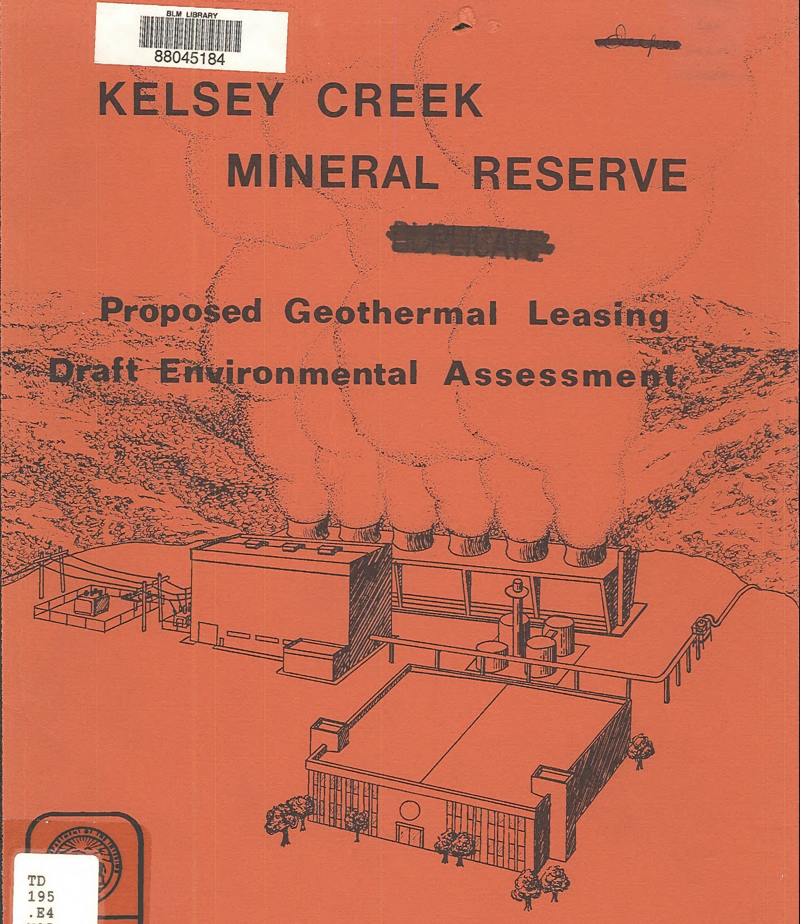
Proposed Geothermal Leasing
Draft Environmental Assessment



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DRAFT
ENVIRONMENTAL ASSESSMENT
KELSEY CREEK
PROPOSED GEOTHERMAL LEASING

May 1981

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TABLE OF CONTENTS

PAGE

CHAPTER 1 - PURPOSE OF AND NEED FOR THE PROPOSED ACTION 1-1

CHAPTER 2 - ALTERNATIVES INCLUDING THE PROPOSED ACTION 2-1

ISSUES 2-1

Air Quality 2-1

Water Quality 2-1

Land Use 2-1

PROPOSED ACTION 2-1

Introduction 2-1

Study Area 2-3

Development Scenario 2-3

Development Procedures 2-9

Applicable Laws and Regulations 2-11

Lease Stipulations 2-13

Parameters 2-15

Bureau Actions 2-19

ALTERNATIVE 2-20

CHAPTER 3 - AFFECTED ENVIRONMENT 3-1

CLIMATE 3-1

AIR QUALITY 3-1

NOISE 3-5

GEOLOGY 3-5

General Geology 3-5

Geologic Hazards 3-7

CHAPTER 3 - AFFECTED ENVIRONMENT (Cont.)

PAGE

SOILS 3-7

VEGETATION 3-9

General Vegetation 3-9

Sensitive Species 3-9

Plant Communities 3-13

WILDLIFE 3-17

Terrestrial Wildlife 3-17

Aquatic Wildlife 3-22

PALEONTOLOGY 3-23

VISUAL RESOURCES 3-23

Landscape Character 3-23

Scenic Quality 3-24

Sensitivity and Distance Zones 3-24

Management Classes 3-25

LAND USES 3-25

TRANSPORTATION NETWORK 3-27

SOCIOECONOMICS 3-28

Population and Residential Use 3-28

Employment 3-28

Taxes 3-28

Infrastructure 3-29

Public Attitudes and Expectations 3-29

Other Economic Land Uses 3-29

CULTURAL AND SOCIOCULTURAL RESOURCES 3-30

CHAPTER 3 - AFFECTED ENVIRONMENT (Cont.)

PAGE

Archaeological Field Investigations 3-30

Native American Sites Inventory 3-31

HYDROLOGY, WATER QUALITY, AND WATER USES 3-31

CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES 4-1

PROPOSED ACTION 4-1

Climate, Air Quality, and Noise 4-1

Geologic Hazards 4-6

Soils 4-7

Hydrology and Water Quality 4-8

Vegetation 4-8

Wildlife 4-9

Paleontological Resources 4-10

Cultural and Sociocultural Resources 4-10

Visual Resources 4-11

Land Uses 4-14

Transportation Network 4-14

Unavoidable Adverse Impacts 4-14

Short-Term Uses Versus Long-Term Productivity 4-21

Irreversible and Irretrievable Commitment of Resources . . 4-22

NO LEASE ALTERNATIVE 4-23

CHAPTER 5 - PARTICIPATING STAFF 5-1

CHAPTER 6 - AGENCIES, ORGANIZATIONS, AND PERSONS RECEIVING COPIES OF THIS EA 6-1

FEDERAL AGENCIES 6-1

CHAPTER 6 - AGENCIES, ORGANIZATIONS, AND PERSONS RECEIVING COPIES OF THIS EA (Cont.)

PAGE

STATE AGENCIES 6-1

COUNTY AGENCIES 6-2

SURFACE OWNERS 6-3

GEOTHERMAL DEVELOPERS 6-3

OTHER INTERESTED PARTIES 6-4

REFERENCES CITED R-1

APPENDICES

APPENDIX A - List of Sensitive Plant Species That May Occur in the Study Area A-1

APPENDIX B - Cultural Resource Site Descriptions A-9

APPENDIX C - Visual Resources Contrast Ratings--Geothermal Activities A-11

LIST OF TABLES

No. Title Page

1 Kelsey Creek Mineral Reserve Private Properties (Surface) 2-2

2 Surface Disturbance - Exploration Drilling 2-8

3 Surface Disturbance - PG&E Unit 11 Leasehold 2-10

4 Comparative Summary of Impacts 2-22

5 Ambient Air Quality Standards 3-3

6 Ambient Sound Levels at Receptor Sites in the Vicinity of the Proposed NCPA/Shell Geothermal Power Plant 3-6

7 Soil Characteristics 3-10

8 Sensitivity to Disturbance and Importance of Kelsey Creek Habitats for Terrestrial Wildlife. . . . 3-18

9 Power Plant Hydrogen Sulfide Abatement Schedule 4-3

10 Predicted Noise Levels Due to Activities at the NCPA/Shell Power Plant Site 4-5

11 Sound Levels Associated with Geothermal Development Activities 4-5

12 Summary of Unavoidable Impacts on Terrestrial Wildlife 4-17

LIST OF MAPS

No. Title Page

1 Regional Map 2-4

2 Study Area Map 2-5

3 Study Area Map 2-6

4 Geysers Vicinity Map/Power Plants 2-21

5 Slope Stability 3-8

LIST OF MAPS (Cont.)

No.	Title	Page
6	Soils Map	3-11
7	Plant Communities	3-12
8	Potential Habitat for Sensitive Plant Species	3-14
9	Wildlife Sensitive Areas	3-19
10	Visual Resource Management Classes	3-26

CHAPTER 1

PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of this action is to lease Federal geothermal resources and to ultimately generate electrical power.

With present air quality and other limitations on coal and oil and gasfired electrical generating plants and the moratorium on nuclear power plants in California, geothermal power is one of the few alternatives remaining capable of meeting short-term electrical energy demands.

It is a policy of the Bureau of Land Management to lease Federal energy resources for exploration, production, and utilization of their energy potential. This policy is the result of various Federal laws, primarily the Mineral Leasing Act of February 25, 1920 (coal, oil and gas, and other minerals) and the Geothermal Steam Act of December 24, 1970.

CHAPTER 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

ISSUES

The major issues associated with geothermal leasing in The Kelsey Creek area are: (1) air quality, (2) water quality, and (3) land use. These were identified as major issues by scoping meetings preparatory to the writing of "Mineral Reserve Land EAR #1" (1978). Observations were also made of the major problems associated with the development of geothermal steam on adjoining areas.

Air Quality

Prevailing winds cause hydrogen sulfide emissions from the existing power plants and shut-in steam wells to drift several miles from the source into receptor areas in Lake County. The hydrogen sulfide emissions sometimes exceed the ambient air quality standards.

Water Quality

Steep topography, erosive soil types, and heavy precipitation make construction of roads, pads, and other facilities associated with geothermal steam development extremely difficult. The construction of roads and drill pads usually requires extensive cut and fill work and can expose fairly large areas of erodible soils to the high intensity rains that are common to The Geysers area. The accumulation of water, laden with soil from the unpaved surfaces, is diverted into steep drainage channels and carried into the main drainage system. Water quality is affected, not only in The Geysers field, but also in areas far downstream.

Land Use

The Kelsey Creek Study Area consists of approximately 902 acres of mineral reserve lands. Mineral reserve lands have the mineral rights reserved to the United States and the surface is in private ownership. The surface owner(s) use the land for such things as hunting, fishing, or general recreation, and sometimes lease the surface for income. If the area is developed for geothermal steam, a portion of the surface is totally altered, precluding other surface uses. Industrialization will diminish other values (residential, recreation, etc.) on undisturbed adjacent lands.

PROPOSED ACTION

Introduction

The proposed action is to lease for the development of geothermal resources 902 acres of mineral reserve land (MRL) located within The Geysers Known Geothermal Resource Area (KGRA) (Table 1).

TABLE 1

Kelsey Creek Mineral Reserve Private Properties (surface)

Name and Address	T. & R.	Subdivision	Acres	Acres/A.P.	A.P. #
Robert L. and Carolyn Henderson P.O. Box 542 Kelseyville, CA 95451	12N 9W	Sec. 11, Lots 4, 5, 7, 8	182.34	182.34	011 004 11 00
		Sec. 13, S½NW¼	80	280	011 006 02 00
		Sec. 14, S½NE¼ N½NW¼, SE¼NW¼	200		
Robert W. and Thomas E. Binkley 1520 Maxwell Ln. Bloomington, Indiana 47401	"	Sec. 25, SW¼NW¼ & NW¼	200	360	011 007 01 00
		Sec. 26, NE¼	160		
		Sec. 24, S½SW¼	80	80	011 006 01 00

902.34 Acres Total

With the passage of the Geothermal Steam Act of 1970 (30 U.S.C. 1001-1025), the Secretary of the Interior was granted the authority to issue leases for geothermal development. This authority applies primarily to public land but also includes ". . . lands which have been conveyed by the United States subject to a reservation to the United States of the geothermal steam and associated geothermal resources herein." This authority has been delegated by the Secretary of the Interior to the Director, Bureau of Land Management.

On December 29, 1916, with the passage of the Stockraising Homestead Act, the surface estate and mineral estate on the public lands were divided for the purpose of disposal. Section 299 of the 1916 act states ". . . patents issued under provisions of . . . this title shall be subject to and contain a reservation to the United States of all coal and other minerals in the lands so entered and patented, together with the right to prospect for, mine, and remove the same."

Utilizing BLM procedures in existence prior to Civil No. 72-1886-GBH -- United States vs. Union Oil Company -- the United States is able to lease geothermal resources occurring on mineral reserve lands (MRL) in The Geysers. Approximately 31,770 acres of MRL occur in The Geysers-Calistoga KGRA. This environmental assessment (EA) evaluates 902 acres of MRL situated north of the producing field. The EA represents an update of the environmental statement prepared by the Department of Interior in 1974, *The Geysers Mineral Reserve Land (Five Tract) EA* prepared in 1978, and *The Geyser Peak Mineral Reserve EA* prepared in 1980.

The area was selected for study to: (1) allow exploration and possible development of geothermal resources northwest of the proven field, (2) if present, allow the efficient utilization of the steam reservoir, and (3) comply with industry nominations.

Study Area

The lease Study Area is situated in Lake County north of The Geysers geothermal field, and approximately 110 miles north of San Francisco (Map 1). Both tracts are situated within the Kelsey Creek drainage basin (Maps 2 and 3).

Because this area is within the boundaries of The Geysers KGRA and directly adjacent to current geothermal development, all leasing will be on a competitive basis. The particular areas selected for evaluation are for environmental evaluation only and not intended to forecast any potential lease boundaries. The U.S. Geological Survey (USGS) establishes the size and location of lease boundaries.

Development Scenario

The Study Area is adjacent to the proven geothermal field, and it is anticipated that the resource will be the vapor-dominated, dry-steam system found throughout The Geysers. In this type of system, geothermal development can be divided into five general stages:

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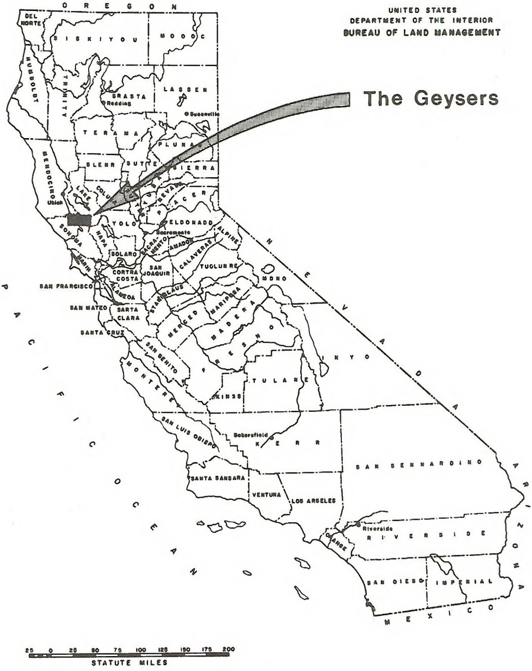
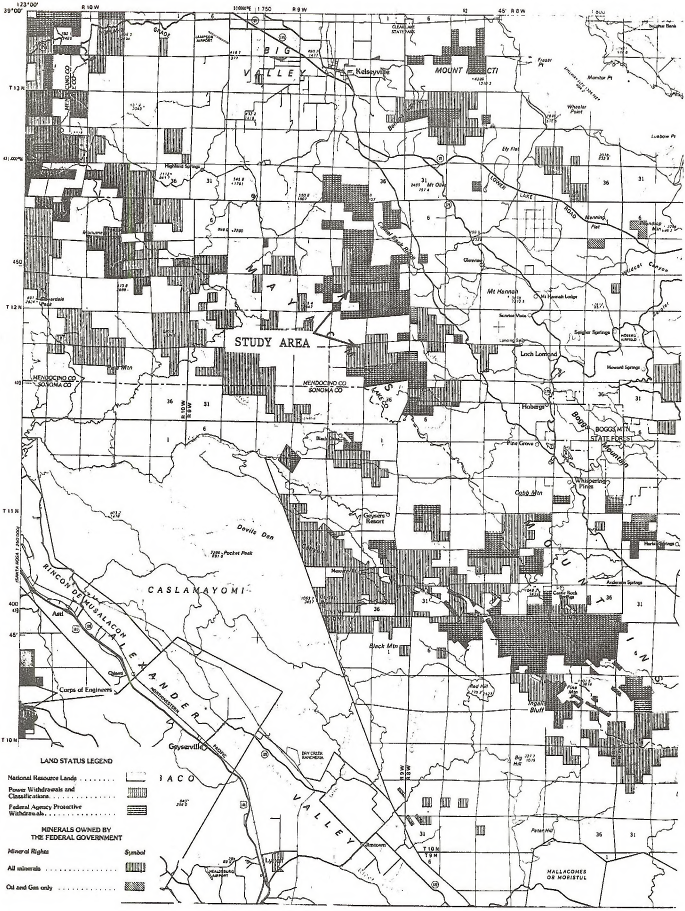


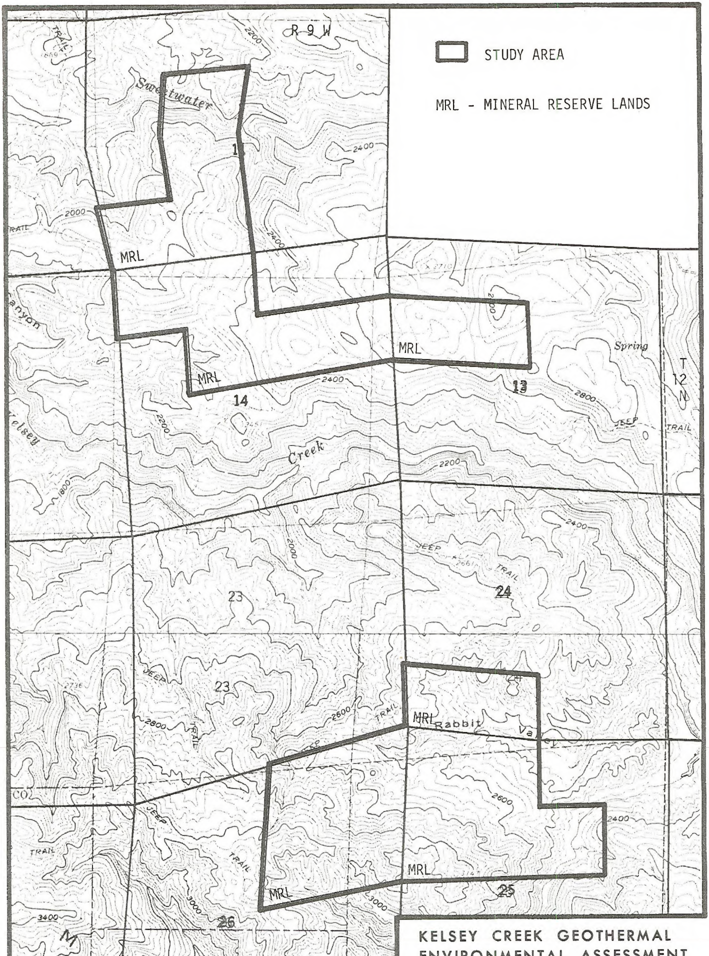
The Geysers

**KELSEY CREEK GEOTHERMAL
ENVIRONMENTAL ASSESSMENT**

MAP 1


123°00'
39°00'
R 10 W
R 9 W
45' R 8 W
T 13 N
T 12 N
T 11 N
T 10 N
BIG VALLEY
Kelseyville
MOUNT KONOCTI
CLEAR LAKE STATE PARK
LAMPSON AIRPORT
Sulphur Bank
Monitor Pt
Fraser Pt
Wheeler Point
Lasbow Pt
Ely Flat
LOWER LAKE ROAD
Manning Flat
Wildcat Canyon
Highland Springs
Mt Olive
Camel Back Ridge
Glenview
Mt Hannah
Mt Hannah Lodge
Sunrise Vista
Siegler Springs
HOBERG AIRFIELD
Loch Lomond
Howard Springs
Hobergs
Boggs Mountain
BOGGS MTN STATE FOREST
Pine Grove
Whispering Pines
Cobb Mtn
MAYACMAS
STUDY AREA
MENDOCINO CO
SONOMA CO
LAKE CO
Cloverdale Peak
Black Oaks
Geysers Resort
Devils Den Canyon
Pocket Peak
CASLAMAYOMI
RINCON DE MUSALACON
ALEXANDER
Asti
Chianti
Corps of Engineers
NORTHWESTERN PACIFIC
Geyserville
DRY CREEK RANCHERIA
SOTOYOME
VALLEY
Jimtown
Lytton
HEALDSBURG AIRPORT
Mercuryville
Castle Rock Springs
Black Mtn
Red Hill
Ingalls Bluff
Pine Mtn
Big Hill
Peter Hill
Harbin Springs
Anderson Springs
MOUNTAINS
MALLACOMES OR MORISTUL
T 10 N
T 9 N
LAND STATUS LEGEND
National Resource Lands
Power Withdrawals and Classifications
Federal Agency Protective Withdrawals
MINERALS OWNED BY THE FEDERAL GOVERNMENT
Mineral Rights
Symbol
All minerals
Oil and Gas only

MAP 2



KELSEY CREEK GEOTHERMAL ENVIRONMENTAL ASSESSMENT

Contour Interval 40 Feet

Scale 1 : 24,000

MAP 3

Preliminary Exploration

Exploration prior to leasing for Geothermal development includes nonintensive uses of the land, such as geologic and land mapping, geochemical and geophysical surveys, water analysis and temperature studies, and possible shallow (300-500') temperature gradient holes. The discrete operations are:

1. Off-road foot traffic.
2. Existing road or trail vehicle use.
3. Off-road light vehicle use.
4. Possible trail improvement for temperature gradient holes.

The temperature gradient holes usually require no more than a few days to drill and they are normally limited to existing roads and trails. It is expected that only small amounts of trail improvement would be necessary to move in the truck-mounted drilling equipment.

Exploration Drilling

Exploration drilling is the drilling of the first full-scale wells to prove the existence and limits of the geothermal resource. The discrete operations are:

1. Road construction.
2. Drill site construction.
3. Truck and other vehicle travel.
4. Drilling.
5. Well testing.
6. Waste disposal.
7. Well venting or bleeding.

A series of deep test wells are necessary to evaluate the extent of the resource. The drill locations are selected on the basis of findings during the initial exploration. This phase requires the use of a large drilling rig and associated large trucks. For example, Table 2 lists surface disturbance expected during this stage. Actual acreage will vary depending on topography, existing road network, and other factors.

Field Development

Field development is the continued drilling in order to provide enough reserves to supply a power generation facility. It is assumed that, as in adjacent areas, approximately 16 wells are necessary to support one 110-megawatt power plant. Based on the estimate that from 800 to 1,000 surface acres are required to support one 110-megawatt power plant (Nielson et al. 1975), it is possible if full development occurs, that one 110-megawatt generation facility could be supported from the proposed lease area. The discrete operations are the same as exploration

TABLE 2*

SURFACE DISTURBANCE - EXPLORATION DRILLING

Approximate surface disturbance expected to result from exploration drilling on one 2,560-acre lease.

Unit	No. of Acres Disturbed Per Unit	No. of Units	Acres Disturbed
Well Sites	3.0	6	18
Access Road	1.5	5	8
Total	4.5	11	26

or 1.0% of total lease area (2,560 acres)

*Adapted from the "Final Environmental Analysis Record for Proposed Geothermal Leasing in the Randsburg - Spangler Hills - So. Searles Lake Areas, California." Prepared by Bureau of Land Management, Riverside District Office, July 1976.

drilling, but much more intensive. Table 3 shows the surface disturbance that occurred on the Pacific Gas and Electric Unit 11 leasehold. There are additional discrete operations as follows:

1. Power plant construction.
2. Pipeline construction.
3. Electric transmission line construction.

Production of Steam and Electricity

Production of steam and electricity involves full operation and maintenance of all facilities. A minimum amount of make-up drilling is necessary to provide replacement wells. This usually occurs from existing pads. The discrete operations are the same as in exploration drilling.

Total Closeout of Operations

Closeout takes place after geothermal resources can no longer be economically extracted from the reservoir. The discrete operations are:

1. Abandonment of wells.
2. Removal of surface equipment.
3. Surface reclamation and restoration.
4. Relinquishment of leases, rights of way, etc.

Development Procedures

The procedures and roles of the various Federal agencies during geothermal development on the mineral reserve lands follows. More detail can be found in "Memorandum of Understanding for the Geothermal Program" (1976) between the U.S. Geological Survey (USGS), the BLM, and the U.S. Fish and Wildlife Service (FWS); in *Title 43, Code of Federal Regulations*, "Subpart 3814 - Disposal of Reserved Minerals Under the Stockraising Homestead Act"; and in a letter of agreement between the USGS and the California Department of Oil and Gas (CDOG) (1979). This information is available to the public at the Ukiah District Office, 555 Leslie Street, Ukiah.

After the prelease environmental assessment is circulated for public review, BLM will make the final decision on which parts of the Study Area to lease. The land selected will be leased via competitive bidding. After the lease is awarded, the USGS becomes the lead agency for field development, as delegated by the Secretary of the Interior.

Prior to occupancy of the surface of lands patented under the Stockraising Homestead Act of December 29, 1916, (39 Stat. 862; 43 U.S.C. 291-302) the lessee must first obtain written consent or waiver from the surface owner; or, second, pay for damages to crops or other tangible improvements to the owner under agreement; or, third, in lieu of either of the foregoing provisions, execute a good and sufficient bond or undertaking (as determined by regulations) to the United States for the use and benefit of the entryman or owner of the

TABLE 3*

SURFACE DISTURBANCE - PG&E UNIT 11 LEASEHOLD

Surface disturbance occurring from Pacific Gas and Electric Unit 11 Leasehold - 110 MW - 739.2 acres.

Land Use	Acres	% of Leasehold
Well Pads	18.8	2.5
Power Plant	6.0	0.8
Road	11.6	1.6
Pipelines	2.5	0.3
Transmission Lines	3.9	0.5
Replacement Wells	7.9	1.1
Total	50.7	6.8

*The information on this table was supplied by Mr. W.C. Chouteau of Pacific Gas and Electric Co. The total percentage of surface disturbance will be approximately the same, regardless of the total lease area. This information applies to a dry-steam resource only.

land, to secure payment of such damages as may be determined or fixed in an action brought upon the bond in a court of competent jurisdiction against the principal and sureties thereon.

The California Division of Oil and Gas (CDOG) and the county governments are responsible for issuing permits for geothermal development on private lands and minerals. Because the land included in this study has split ownership (private surface-federal mineral), the State and county regulatory process must be meshed with the Federal process. To accomplish this, the CDOG and the USGS have agreed that the USGS will be the lead agency for Federal surface or private surface underlain by Federal mineral estate. The USGS has also agreed to use county standards where such standards are more stringent than Federal standards.

Before development can be initiated, the lessee must file a Plan of Operation (PO) with the USGS for the joint approval of the Area Geothermal Supervisor and the BLM District Manager. The plan of operation identifies a specific well pad and/or road that the lessee proposes to construct. The USGS prepares an environmental assessment (EA) for the proposed project. A field inspection is provided by USGS for all interested parties to see the proposed development site. The USGS also requests comments from interested parties on the proposal for inclusion in the EA. Upon completion of the EA and the development of mitigating measures, the plan of operation is approved. Following approval, the USGS sends a sundry notice to the lessee to commence construction.

During construction, the project is inspected periodically by the USGS and BLM to assure that the project is constructed in accordance with the plan of operation and the mitigating measures identified in the EA.

As the federal lease is developed, this process is repeated numerous times.

Applicable Laws and Regulations

Laws and regulations generally provide only broad guidelines, which must be properly interpreted and incorporated into each lease based upon particular social, economic, land use, natural resource, cultural resource, environmental, or other significant considerations. Some laws, especially those dealing with endangered species and cultural resources, are more explicit, and procedural actions are required in specified circumstances. Enforcement authority for the various laws and regulations regarding operations on a Federal geothermal lease has been delegated by Secretarial order to the U.S. Geological Survey (USGS). Although monitoring is done by several Federal, State, and local regulatory agencies, the USGS is the official contact with the lessee regarding leasehold operations. Discrepancies observed by other agencies are reported to the USGS, which takes the necessary action against the offending lessee.

Following is a list of some of the laws and regulations affecting geothermal development of public and mineral reserve lands. This is not intended to be a complete list of all laws and regulations, but rather a compilation of the more important statutes.

Statutes and Regulations	Compliance Authority
Title 43, Code of Federal Regulations, Subpart 3200	BLM
Title 30, Code of Federal Regulations, Subpart 270 & 271	GS
Title 40, Code of Federal Regulations, Subpart 1500 (Council on Environmental Quality Guidelines)	BLM, GS
Title 36, Code of Federal Regulations, Subpart 800 (Procedure of the Advisory Council on Historic Preservation)	BLM
Geothermal Resource Operational (GRO) Orders	BLM, GS, FWS
Federal Land Policy and Management Act of 1976 (Public Law 94-579,90 Stat. 2743)	BLM
National Environmental Policy Act of 1969 (Public Law 91-190, 83 Stat. 852)	BLM, GS FWS, EPA
Endangered Species Act of 1973 (Public Law 93-205, 84 Stat. 384)	BLM, GS FWS
Clean Air Act of 1977 (Public Law 91-581, 84 Stat. 1566)	BLM, GS FWS, APCD
Clean Water Act (P.L. 95-217)	BLM, GS FWS, State
The National Historic Preservation Act of 1966 (Public Law 89-655)	BLM, GS
Executive Order 11593 of May 13, 1971 (pertains to cultural resource management)	BLM, GS
The various other state and local laws and rules such as those enforced by the Air Resources Board (ARB)	State, Local agencies, BLM, GS
Antiquities Act of 1906 (Public Law 59-209, 34 Stat. 225)	BLM
Historic Sites Act of 1935 (Public Law 84-292, 49 Stat. 666)	BLM

Copies of Federal laws and regulations are available for review at the Ukiah District Office of the Bureau of Land Management.

Lease Stipulations

The following special lease stipulations were developed primarily to supplement the standard lease terms, the Geothermal Resources Operational Orders, and the Federal geothermal regulations. Based upon public, industry, and agency review of this draft report, additional lease stipulations may be added. The following stipulations may also be modified or eliminated as a result of the review process.

A. Stipulations For All Leases Offered

1. The lessee shall, at the descretion of the Deputy Conservation Manager (DCM, Geothermal), prepare a water quality monitoring plan for the lease. The plan shall be prepared and implemented to the satisfaction of the DCM, Geothermal, and the BLM District Manager, by the lessee at the lessee's sole expense. If more than one lease is involved, this expense shall be shared among all lessees.

2. The lessee shall pave all roads that are authorized and constructed by the lessee under plans of operations when such roads are causing excessive erosion and/or deterioration of water quality as determined by the DCM, Geothermal, and the BLM District Manager.

3. The lessee shall not restrict, prohibit, or otherwise prevent the use of roads authorized and constructed under plans of operation on the lease area, when the use of such roads is necessary for the development of geothermal resources on lands outside the lease area, as determined by the BLM District Manager and the DCM, Geothermal. Road maintenance costs shall be shared jointly by the road users based on a percentage of use. If the road users cannot agree jointly to the percentage of use and maintenance costs, the DCM, Geothermal, will make those determinations.

4. The lessee shall not construct roads or other improvements within 700 feet (measured horizontally) of streams or within 300 feet of ephemeral or seasonal streams unless authorized by the DCM, Geothermal, and the BLM District Manager.

5. The lessee shall provide the DCM, Geothermal, prior to approval of plans of operations, a statement or waiver signed by the surface owner that the proposed projects and/or geothermal development is acceptable to the landowner. In lieu of such approval by the landowner, the lessee shall adhere to the procedures identified in 43 CFR 3814.1.

6. The lessee shall provide the DCM, Geothermal, a detailed botanical report of the vegetation to be disturbed and/or affected by a plan of operation. The required inventory and report shall be accomplished as described in the *Kelsey Creek Mineral Reserve Environmental Assessment* and in accordance with any special requirements of the District Manager, Bureau of Land Management, Ukiah, California.

7. The lessee, in accepting this lease, acknowledges that all or portions of the surface of the leased lands are privately owned. The lessee further acknowledges that utilization of geothermal resources on privately owned lands is not authorized under this lease. If the lessee desires to construct utilization facilities on such lands, consent must be obtained from the surface owner(s). The lessee is hereby informed that the United States will not participate as a third party in such negotiations and any agreement reached between the lessee and the surface owner(s) will not be binding on the United States. Failure to obtain an agreement with the surface owner(s) will not affect in any way the terms or requirements of this lease.

8. The lessee shall, if requested by the surface owner, control the access to the operational lease areas limiting entry to the lessee, contractor, and other authorized personnel. The lessee shall not be held liable for unauthorized entry or trespass. The public access provisions of Geothermal Resource Operational Order No. 4 and Subpart 3204.1(b)(1) Title 43, Chapter II of the *Code of Federal Regulations* does not apply to the leased Mineral Reserve Lands (MRL). The public does not have the right to free and unrestricted access to MRL.

B. Site Specific Stipulations

1. T. 12 N., R. 9 W., MDBM, Section 11, NW¼SE¼NW¼
Section 14, S½NE¼NE¼
Section 25, E½SW¼NE¼

The lessee shall, prior to any surface disturbance on the lease area, identify the location and estimate the populations of the plant species *Streptanthus morrisonii* ssp. *elatus; S. morrisonii* ssp. *birtiflorus; S. morrisonni* ssp. *morrisonii;* and *S. brachiatus*. Geothermal development activities conducted by the lessee shall not adversely affect the above described plant species.

T. 12 N., R. 9 W., MDBM, Section 14, SW¼NE¼NW¼
Section 24, S½SE¼SW¼
Section 25, N½NE¼NW¼

The lessee shall not disturb the vernally wet grasslands located on the above described land.

T. 11 N., R. 9 W., MDBM, Sections 11, 13, 14, 24

The lessee shall not disturb the land surface within 200 feet of prehistoric archaeological sites CA-LAK-1116, 1117, 1118, 1124, 1125, 1126, 1127, 1128, 1129, 1130, 1131, and 1132, which are located in the above described sections.

Parameters

The following general guidelines will be used in writing the site-specific project environmental assessment (by USGS) and for developing mitigations and alternatives to proposals:

1. Avoid areas of active, deep, or potentially active landslides unless they can be satisfactorily stabilized.

2. To the extent possible, locate sites and structures just below ridgetops on stable lands or along lower spur ridges in bedrock cuts so as not to be visible on the skyline. Wider valley bottoms with a low potential for flooding and slumping would also be suitable with proper siting of structures along edges of valley bottom.

3. Whenever possible, avoid steep side slopes underlain by deep colluvium and/or a weak bedrock mantle. Such slopes are nearly always more susceptible to damaging landslides.

4. Carefully select access alignments so they avoid, to the extent possible, existing active landslides and steep colluvium-mantled slopes.

5. All cuts and fills will be minimized. To the extent possible, design on the basis of balanced cuts and fills, unless site conditions do not permit placement of a suitably stable fill.

6. Avoid placing large volumes of spoilage (excess oil and rock) from site construction on active landslides. It may be acceptable to place the spoilage on large dormant or static slides. Spoilage should not be permanently stored on steep side slopes; temporary side slope storage may be acceptable.

7. Whenever possible, avoid disturbing areas that are susceptible to mass movement, slumps, and soil creep.

8. Minimize side-casting of soil and rock from road and site construction.

9. A slope stability monitoring program to provide warning of incipient instability may be advisable for some well sites. It will be mandatory for those wells proposed for siting on large, ancient, inactive slides. Siting on other more recently active landslides is not advisable unless adequate corrective and preventive measures have been undertaken.

10. Intercept surface drainage from roads with culverts or suitably-lined ditches and transport it to the nearest stream course. Install energy dissipators in soil or weathered rock at all outfalls.

11. Place surface drainage structures of adequate size and type as necessary.

12. Install culverts of adequate diameter, as necessary, and inspect regularly to see that they are kept free of debris. Place trash racks over culverts that drain large, steep-gradient gullies and streams.

13. Keep road width to a practicable minimum.

14. Locate roads and pads along ridgetops to the extent possible, if consistent with other resource management objectives.

15. On hillside alignments, slope the road surface into the hillside.

16. Prior to the first rain, seed all fill slopes.

17. In the event that steam in commercial quantities is not discovered, abandon the pad and servicing roads by scarifying the pad and road surface, replacing stockpiled topsoil, fertilizing as required, and planting with suitable grasses and/or shrubs.

18. Geotechnical investigations for design of well pads and access roads will be conducted by a licensed civil engineer specializing in the practice of soil mechanics and by a certified engineering geologist.

19. Avoid road construction on slopes over 60 percent.

20. No vegetation disturbance will be allowed beyond the limits of the actual construction area. This is especially vital on the serpentine soils Henneke and Montara.

21. Should crossing of buffer strips be necessary, it will be done at right angles to the stream, never closely paralleling the stream, and only during times of low or no flow in the stream.

22. Roadside vegetation will be specified in all plans of operation. All cut and fill slopes and other disturbances must be revegetated where feasible. Revegetation efforts will continue yearly until a minimum of 60 percent ground cover is achieved. Revegetation efforts will be completed prior to the start of the rainy season each November.

23. Road grades will be kept to a maximum of 8 percent, except for a few minor 12 percent maximum short pitches.

24. All-weather, hard-surface, bituminous pavement will be required on roads and ditchlines to power plant sites and appurtenant structures. This is necessary due to the high rate of erosion that occurs on unpaved access roads.

25. Steamlines will take the shortest environmentally acceptable route to the power plant. Clearance of vegetation to allow construction of steamlines will be done by hand methods, leaving plant root crowns that will sprout rapidly during wet weather to establish ground cover. This practice shall also apply to roads used for exploratory purposes

or other temporary access roads. Clearing will not be done by tractors or other heavy machinery on critical areas.

26. Where environmentally sound, existing roads and trails will be used for lease development.

27. All electric transmission facilities should incorporate approved specifications to prevent the electrocution of raptors. Detailed state-of-the-art information is available from the Raptor Research Foundation, Inc. (1979).

28. Where appropriate, common rights-of-way will be obtained for use in the development and operation of leases. This measure is expected to reduce overall road construction and the resultant loss of habitat.

29. High-value wildlife plants that occur naturally at the particular site will be re-established where possible. Such desirable plants include the oaks and particularly black oak, madrone, *Ceanothus* (three species), mountain mahogany, toyon, coffee berry and conifers.

30. Groups and individuals of the larger tree species and snags will be retained where possible. Of particular importance are large conifers, oaks, and madrones. Retention of these species is important wherever encountered, but especially so where they occur in pockets surrounded by lower vegetation.

31. To minimize the potential for negative visual impacts, a professional Landscape Architect will develop site planning and design criteria for facilities to be constructed, using in part the following guidelines.

    a. Locations will be selected that maximize the opportunities to use landform and vegetation for natural screening, and that also minimize surface disturbance.

    b. All clearing of vegetation will leave irregular edge patterns that repeat, as nearly as possible, natural edges and patterns of existing openings.

    c. All altered or created landscapes will be contoured and graded to existing landform character.

    d. Steep slopes (over 3:1) will be serrated, benched, or will utilize planting pockets in rocky areas in order to enhance revegetation potential.

    e. Revegetate disturbed areas with indigenous plant materials capable of surviving conditions inherent of the site and specific microclimates. Plant materials will be selected for compatibility and continuity with natural vegetation patterns (introduced species of temporary ground covers may be used to minimize erosion potential by providing immediate cover until native species are established).

f. Mulch/fertilizer mixes will be used to temporarily stabilize disturbed surfaces and provide nutrients and protection for seeds and/or potted seedlings.

g. Structures (i.e. transmission towers, bridges, drainage pipes, retaining walls, etc.) will be designed to complement and take advantage of the existing landscape character and reduce contrasts.

h. Lattice-type transmission towers painted to site-specific specifications will be used whenever feasible to help blend the transmission system into the landscape.

i. Any structure, permanent or temporary, shall be located, whenever feasible, below major ridgelines to avoid silhouette effects against the skyline.

j. All structures shall be painted with nonreflective paint, colored to meet site-specific requirements, to blend with the surrounding natural landscape.

k. Road alignments will take advantage of existing natural lines in the landscape between distinct slope changes or will locate roads in the least obvious areas of visual prominence. Alignments should curve to follow the natural landforms to minimize unnatural lines contrasting with the existing landscape.

l. Wells will be consolidated as much as geotechnically practical and feasible to minimize the network of pipelines.

32. Fencing, signing, or other measures may be required to protect cultural sites.

33. Prior to approval of a plan of operation, a site-specific botanical survey for the specified project will be done and will include:

a. A botanical survey of the area to be disturbed, including a 100-foot-wide buffer on either side. The survey will be conducted by a competent botanist acceptable to the authorized officer, and it will cover one flowering and fruiting season.

b. A report submitted to the BLM, USGS, and lessee that includes a species list for each site surveyed, a map showing the location and boundaries of any sensitive species, and recommendation for mitigation.

34. If in connection with operations the lessee, his contractors, subcontractors, or the employees of any of them discovers, encounters, or becomes aware of any objects or sites of cultural value on the contract area, such as historic or prehistoric ruins, graves or grave markers, fossils, or artifacts, the lessee shall immediately suspend all operations in the vicinity of the cultural value and notify the District Manager of the findings. Operations may resume at the dis-

covery site upon receipt of written instructions and authorization from the Geothermal Supervisor in consultation with the BLM District Manager.

35. If disturbance of any chert or limestone outcrop is anticipated, a competent paleontologist will be enlisted to sample the locality for evaluation of the scientific significance of fossilization.

36. There will be no construction of exploration trails, roads, steam lines, or drill pads during the rainy season (October 1 to April 1, both days inclusive).

37. Contact the BLM District Manager immediately upon any incident involving spilling or discharge of oil, toxic waste, or other deleterious substance.

38. Notify landowners as soon as construction and drilling schedules are available.

39. There will be no surface disturbing activities on the Henneke-Montara-Rock outcrop soils on slopes over 40 percent.

Bureau Actions

Cultural Resources

The Bureau is required to identify, evaluate, and protect cultural resources on public lands under its jurisdiction and to ensure that Bureau-initiated or Bureau-authorized actions do not inadvertently harm or destroy Federal or non-Federal cultural resources. These requirements are mandated by the Antiquities Act of 1906; the Reservoir Salvage Act of 1960, as amended; the National Environmental Policy Act of 1969; Executive Order 11593; and the Federal Land Policy and Management Act of 1976.

To protect and preserve significant cultural resources, the Bureau will ensure that Class III intensive field inventories are completed prior to authorizing any project in areas not previously examined by an archaeologist. All inventories will be completed by a qualified professional archaeologist (36 CFR 66).

If it is impossible to avoid prehistoric or historic sites, methods of data retrieval must be developed, such as surface collection and/or excavation. All data retrieval programs will conform to those standards set forth in 36 CFR 66.

To fulfill the obligations of the BLM under Section 106 of the National Historic Preservation Act of 1966 and Executive Order 11593, a proposal for a Programmatic Memorandum of Agreement (PMOA) has been prepared by the BLM and will be submitted to the Advisory Council on Historic Preservation and the State Historic Preservation Officer. In conjunction with the finlized PMOA, a Historic Preservation Program for The Geysers-Calistoga KGRA (which includes the Study Area) will be prepared by the BLM. This Historic Preservation Program will be designed to ensure protection and preservation of significant cultural resources, including the 12 archaeological sites recorded within the Study Area. This process is being developed pursuant to 36 CFR 800.8 to streamline the responsiveness of the BLM to energy development.

Sociocultural Resources

The American Indian Religious Freedom Act of 1978 (P.L. 95-341) requires all Federal agencies to evaluate their policies and procedures to determine possible impacts upon the traditional religious practices and beliefs of Native Americans. In accordance with Federal legislation and the Bureau's Memorandum of Understanding with the California Native American Heritage Commission, an inventory of sites significant to Native Americans was completed for the study area.

Endangered Species

Any possible impacts involving endangered species will be resolved through cooperation and consultation with the California Department of Fish and Game and the U.S. Fish and Wildlife Service as required by Section 7 of the Endangered Species Act of 1973, as amended 1978 and 1979.

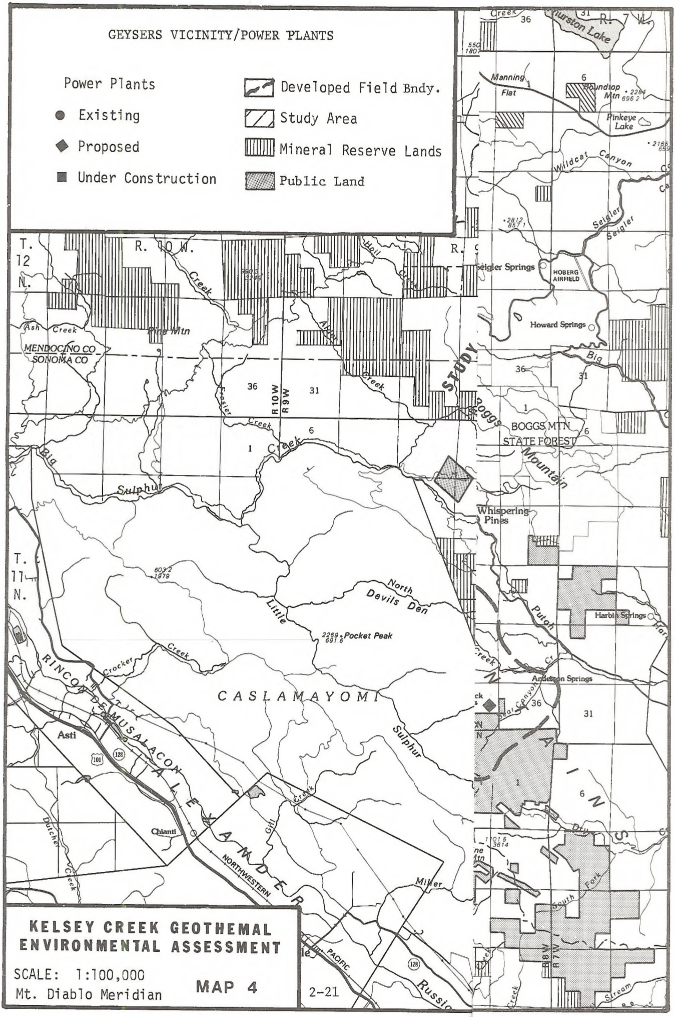
Interrelationships

Currently, there are 15 generating units in operation at The Geysers producing 908 megawatts (MW) of power (Map 4). With the completion of Units 16 through 21 -- the Northern California Power Agency plants, the Department of Water Resources plants, and the Sacramento Municipal Utility District plant -- the generating capacity will be expanded to 1,909 MW, or more than enough to service San Francisco and a portion of Northern California. If the proposed lease area is fully developed, one 110 MW or two smaller additional generating units could be built, raising the total generating capacity at The Geysers to over 2,000 MW. Map 4 shows the location of all operating power plants, those under construction or proposed, and the location of the existing Federal geothermal leases in relationship to the study area.

Lake County has placed their lands within the study area in an unclassified zone.

ALTERNATIVE

The alternative is to not lease the geothermal resources (No Action). See Table 4 for Summary Comparison of Impacts.



KELSEY CREEK GEOTHEMAL ENVIRONMENTAL ASSESSMENT

SCALE: 1:100,000
Mt. Diablo Meridian

MAP 4

TABLE 4

COMPARATIVE SUMMARY OF IMPACTS

COMPONENT or RESOURCE	PRESENT SITUATION/NO ACTION ALTERNATIVE	PROPOSED ACTION ALTERNATIVE
Air Quality	Surrounding development would cause continued degrading of air quality, however, not as quickly as the proposed action.	Air quality would continue to degrade as continued development occurs. This condition may stabilize as abatement systems are improved. A significant change in air quality is likely to occur until such systems are available.
Noise	No ambient sound levels were measured in the study area. Geothermal development in surrounding areas could create a significant impact depending on buffer zones used to shield noise.	The noise associated with geothermal development in this area would be significantly more than the present situation/no action alternative.
Geologic Hazards		
1. Seismic Activity	The method of injection at The Geysers KGRA is under hydrostatic head, as opposed to high pump pressure, therefore the potential from adjacent geothermal development to induce earthquakes by reinjection appears to be small. Further studies are being conducted by USGS.	The methods of development would be similar to past geothermal exploration, and therefore would not induce earthquakes. Further studies are being conducted by USGS to determine effects of geothermal development on seismic activity.
2. Landslides	There would be no significant impact on geologic materials that would result in increased landslides. Most areas have stabilized and are not susceptible to natural landslides. Should surface owners allow development on or access across mineral reserve land to tap adjacent private steam resources, there could be additional landslides on these areas that had a history of movement.	Geothermal development would have a significant impact on slope stability and landsliding in those areas that are susceptible to slope failures. However, should these susceptible areas be avoided, impacts would be insignificant.

TABLE 4

COMPARATIVE SUMMARY OF IMPACTS (cont.)

COMPONENT or RESOURCE	PRESENT SITUATION/NO ACTION ALTERNATIVE	PROPOSED ACTION ALTERNATIVE
Soils	Present erosion of the area is moderate to high depending on soil type, slope, and vegetation.	Mitigating measures should reduce the high erosion hazard, especially on slopes greater than 15%, to a minimal amount of soil loss. Soil productivity would be reduced or lost on between 62 to 132 acres.
Water Quality	Good quality water is being received from the Kelsey Creek watershed. Past records indicate the occurrence of large flood flows, channel scouring, and considerable amounts of sediment delivered into Clear Lake. These occurrences are a natural process in the Kelsey Creek watershed. No additional impacts would be felt from this alternative.	Mitigating measures applied to surface disturbance to lessen impacts are not totally successful, as a cumulative sedimentation and water quality problem will develop as more of the Geysers area is developed.
Vegetation		
1. General	There would be no significant impact on vegetation that would result in the degradation of plant communities.	Temporary (10-25 years) or permanent loss of native vegetation can be expected dependent on the nature of intensity of the surface disturbance activity. A secondary impact could occur with the introduction of exotic plant species. These plant species generally flourish in disturbed areas, thus slowing natural succession of the vegetative community by an unquantifiable amount.
2. Sensitive Species	Little or no impact under this alternative. Rare, threatened, and endangered species are protected by Federal law and mitigations.	There would be little or no impact due to protection by Federal law. Should surface owners allow development on or access across mineral reserve land to tap adjacent private steam resources, there could be significant impact to sensitive species, if they exist.

TABLE 4

COMPARATIVE SUMMARY OF IMPACTS (cont.)

COMPONENT or RESOURCE	PRESENT SITUATION/NO ACTION ALTERNATIVE	PROPOSED ACTION ALTERNATIVE
3. Unique Habitats	Same as Sensitive Species section.	Same as Sensitive Species section.
4. Important Plant Communities	Same as Sensitive Species section.	Same as Sensitive Species section.
Wildlife	Same as Sensitive Species section.	Same as Sensitive Species section.
Cultural Resources	Same as Sensitive Species section.	Little or no adverse impacts are expected. All actions would be cleared by the District Archeologist prior to development.
Visual Resources	In certain areas around the Kelsey Creek study area the only indication of geothermal activities would be occasional steam plumes. There would be no significant adverse impacts on visual resources from this alternative.	The degree of impact is dependent on the site planning and design of specific projects as well as the total development scenario.
Land Use	Present uses would continue. There would be little impact except for the loss of stockraising compensation.	Present uses in The Geysers area would be greatly curtailed, or totally eliminated, as development occurs. Surface owners would be compensated for loss of stockraising habitat and direct damage to improvements should surface owners allow development or access.
Paleontological Resources	Little or no impacts are expected. Paleontological resources are protected by Federal law and mitigations.	Same as Sensitive Species section.

CHAPTER 3

AFFECTED ENVIRONMENT

CLIMATE

The climate of the Study Area is a Mediterranean type climate with warm summers and mild winters, typical of Northern California. The summers are mainly influenced by a high pressure system which lies off the coast of California. The high pressure system forces polar air masses to the north causing hot, dry summers. During the winter this high pressure air shifts to the south and allows frontal systems to pass over the State. Annual precipitation ranges from 25 inches in the northern portion of the KGRA to 80 inches along the crest of the Mayacmas Mountains. The amount of precipitation is generally a function of topography and rain shadow effect -- the higher the elevation, the more the precipitation and, the further south the area, the less influence of the shadow effect from the Northern California coast range. Approximately 95 percent of this precipitation is received from October through April. Summer rain showers occur infrequently.

The directional frequency distribution of the local wind in the area is very complex. At elevations above 3000 feet, the annual average wind flow is either from the NE-45° or the SW-45°. This pattern is observed during all seasons, although the NE direction is more prevalent in winter and the southwest predominant in summer. At lower elevations, directional patterns bear little similarity to patterns found at high elevations, as local terrain becomes increasingly important in determining directional distribution. Diurnal radiational heating and cooling of the earth's surface generates downslope winds at night and upslope winds during the day.

AIR QUALITY

The most difficult environmental effects to analyze and evaluate are the impacts of geothermal power plant emissions on ambient air quality and the effects of deterioration in air quality on surrounding plant, animal, and human populations. Several factors account for this difficulty:

1. Reliable up-to-date information on the existing ambient air quality is seldom available for a specific plant site.

2. Emissions from the plant cannot be accurately predicted prior to actual operations because the exact composition and concentration of chemicals in the incoming steam are not known.

3. The effectiveness of pollution control equipment has not been determined over a period of time long enough to assure the assumed figures are reliable.

4. There is little scientific certainty regarding the nature and extent of harmful effects of geothermal plant emissions on plants, animals, and humans, even after abatement to meet government standards.

Meterological and topographical characteristics of the area surrounding The Geysers KGRA are important in evaluating the effect of its emissions on ambient air quality. The following can be stated concerning the outflow over The Geysers KGRA:

1. There is transport across the Mayacmas Ridge into Lake County.
2. Airflow in northern Lake County is very light and tends to drain into Clear Lake from all directions, and any accumulated pollutants are generally dispersed along the heated slopes during the daytime.
3. The ventilation potential of the area is typically better in the far southern reaches of the County and degrades considerably north and northwest of Cobb Mountain.

The California Air Resources Board (CARB) has classified Lake County as a distinct air basin separate from the North Coast and Sacramento Valley basins. An inventory of the County's ambient baseline air quality was made in March and April of 1975. The CARB measured seven major air quality components at Kelseyville and Middletown in southern Lake County: ozone, carbon dioxide, sulfates, total hydrocarbons, methane, nonmethane hydrocarbons, and coefficient of haze (reduced visability). Their conclusions were that Lake County Air Basin was extremely clean and no California ambient air quality standards were exceeded during this monitoring period, April 14 - May 12, 1975. However hydrogen sulfide (H2S) was not measured in this inventory. (See Table 5).

Air Quality at The Geysers has always been a problem. Prior to the development and use of steam for electrical production, the odor of hydrogen sulfide was noticeable. Ambient air quality in The Geysers KGRA area is influenced by geothermal emissions. Water vapor constitutes about 98 percent of these emissions and the remaining 2 percent are comprised of noncondensible gases and dissolved mineral salts. Noncondensible gases in geothermal steam include carbon dioxide, hydrogen sulfide, methane, ammonia, nitrogen, hydrogen, and ethane. Salts may include mercury, boron, arsenic, and other suspended particulate matter. Radon-222 is also found in geothermal steam.

Of the gases present in the steam, all except hydrogen sulfide are expected to have no significant environmental impact. The presence of H2S is due both to natural sources, such as fumeroles, and to man-made sources, such as well drilling or powerplant operation. The portion of H2S present from natural sources is only a fraction of that present from man-made causes.

Hydrogen sulfide is present in the geothermal steam in The Geysers KGRA and is one of the most noticeable and serious pollutants associated with geothermal development. The California standard of 30 ppb H2S for a one-hour average has consistently been exceeded throughout The Geysers KGRA and the surrounding areas. In 1976, SRI contracted with PG&E and the steam suppliers to accurately quantify the impact of The Geysers on the populated areas of Cobb Valley in Lake County. The significant SRI receptor stations 3, 4, and 7 are near the Study Area. SRI 3 is approximately 2 miles east, SRI 4 is approximately 3½ miles southeast, and SRI 7 is 4½ miles southeast. The data indicates that 1976 H2S levels at SRI 3, 4, and 7 exceeded the State standard .5 percent of

TABLE 5

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standard	Primary Federal Standard
Carbon Monoxide	12 hours	10 ppm(11 mg/m^3)	-
	8 hours	-	10 mg/m^3 (9 ppm)
	1 hour	40 ppm(46 mg/m^3)	40 mg/m^3 (35 ppm)
Hydrogen Sulfide	1 hour	0.03 ppm(4 mg/m^3)	-
Non-Methane Hydrocarbons	3 hours	-	160 ug/m^3 (0.240 ppm)
Lead	30 day	1.5 ug/m^3	-
Nitrogen Dioxide	Annual Average	-	100 ug/m^3 (0.0500 ppm)
	1 hour	0.25 ppm(2.47 mg/m^3)	-
Oxidant (Ozone)	1 hour	0.10 ppm(0.20 mg/m^3)	240 ug/m^3 (0.120 ppm)
Sulfur Dioxide	Annual Average	-	80 ug/m^3 (0.03 ppm)
	24 hours	0.05 ppm(131 ug/m^3)*	365 ug/m^3
	1 hour	0.5 ppm(1310 ug/m^3)	-
Sulfates	24 hours	25 ug/m^3	-
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m^3	75 ug/m^3
	24 hours	100 ug/m^3	160 ug/m^3
Radon-222	Annual Average	3 pCi/1** ***	3 pCi/1** *** 1 pCi/1 ****

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* When standards for total suspended particulates of oxidant are being exceeded.

** Above natural background, at point of release to the environment, in uncontrolled areas.

*** Secondary standards for radon-222 itself.

**** The same conditions as the other radon standards, but radon-222 in combination with its short lived daughters is considered.

Source: California Energy Commission, 1981 the time. In 1977, H2S levels exceeded State standards .05 percent, .7 percent, and .3 percent of the time, respectively.

Another study, the "Cobb Valley Air Quality Impact Study," a multiagency, multisponsor, multiparticipant data acquisition and analysis program, was designed to quantify the impact of three proposed geothermal developments in or near Lake County's Cobb Valley: PG&E Unit 17, Department of Water Resources Bottle Rock Power Plant, and Northern California Power Agency Plant #1. Because these three geothermal developments are located fairly close to the Kelsey Creek Study Area, the data would be relevant. Twenty tests were conducted from September 1978 through April 1979. A draft analysis, "Geyser-Cobb Valley Air Quality Impact Study MRI79 R-1670," was submitted to the Northern Sonoma County Air Pollution Control District (NSCAPCD) and Lake County Air Pollution Control District (LCAPCD) May 22, 1979. Data from the first 16 tracer tests in the study were reviewed to assess both the impacts of the project's 10-year expansion plan and the ambient air quality at the time the projects commence operation. The review of these tests indicated the greatest impact (24.6 ppb H2S) would occur at Pinegrove during a subsidence inversion. The greatest impacts at Hobergs (14.2 ppb H2S), Glenbrook (14.2 ppb H2S), and SRI #7 (12.9 ppb H2S) would occur during nocturnal drainage.

Radon-222 in the atmosphere at The Geysers KGRA was measured by Lawrence Livermore Lab for PG&E during 1975 to 1977 when 11 geothermal power plants were operational. The highest recorded 222Rn concentration in the air was 1.4 pico Curies per liter (pCi/1) at the Stanford Research Institute (SRI) Station 7. This value is below the California Department of Health Services standard of 3pCi/1 above background in uncontrolled areas. Measurements of ambient radon-222 radioactivity have shown that this substance does not occur over the Study Area and would not be expected to occur at high enough levels to pose an environmental problem even in the immediate vicinity of The Geysers power plants.

The national emissions standard developed to restrict atmospheric concentrations of mercury is 1.0 micrograms per cubic meter (ug/m3) averaged over 24 hours. Measurements of ambient mercury in The Geysers area away from the generating units ranged from .001 to .018 uglm3. These levels are well below the ambient standards cited.

The boron concentration in the cooling tower exhaust, estimated by PG&E scientists to be in the order of .098 ppm, should represent no risk to the public health in view of the present knowledge of boron toxicity.

The California ambient air quality standard for suspended sulfates is 25 uglm3 (24 hr. average). The ambient air quality standard is not expected to be exceeded as a result of normal power plant operation or the stacking of the steam supply for a geothermal plant.

Although ambient atmospheric conditions of ammonia (NH3) are not currently monitored at The Geysers, the ambient concentrations in geothermal steam from the cooling towers are measured. This procedure indicates that the ambient concentrations of NH3 in the vicinity of The Geysers are well below the California OSHA standard of 25 ppm. Additionally, the rapid neutralization of NH3 by other components of the ambient atmosphere drastically reduces the possibility that free NH3 will be transported outside The Geysers in hazardous concentrations.

Total suspended particulates (TSP) have been measured through 24-hour samples every six days in the vicinity of The Geysers in three programs. One program (Dec. 2, 1976 to Jan. 31, 1977) measured TSP at four of the SRI sites (Geyser Rock, Anderson Ridge, Pine Summit, and Aidlin Rock). No measurements exceeded the 24-hour State standard.

TSP was measured from Feb. 6, 1977 through Aug. 17, 1977 at 14 different sites. These included all of the SRI sites, PG&E units 5, 6, 7, & 8, Cobb Mountain, Dry Creek, Middletown, and Mercuryville. No measurements exceeded the 24-hour 100 uglm3 over the period of sampling. The third program measured TSP in the Big Sulphur Creek Valley near units 3 & 4 at the Union Oil maintenance shop. Analysis of measurements recorded from April 1975 through June 1976 showed that the State's 24-hour standard of 100 uglm3 was exceeded on only six days.

NOISE

Ambient sound level measurements have been taken at The Geysers since the first quarter of 1973. These measurements and observations have shown that ambient sounds within the geothermal complex can be generally classified into two categories:

1. Sounds originating from natural sources, such as tree and brush movement (wind-related), wildlife, insects, and water flow.
2. Sounds originating from geothermal development, such as construction, operation, and maintenance of steam fields and powerplants.

Ambient levels measured at various locations resulting from natural sources generally establish baseline or residual levels from which the noise impacts of geothermal development can be assessed. Table 6 summarizes ambient sound levels at several sites at the outer fringes of the developing steam field. Although no ambient sound levels were measured on the Study Area, they should be similar to Table 6. Because the Binkley tract is closer to The Geysers field than the Henderson tract, the noise associated with geothermal development would be more significant.

GEOLOGY

General Geology

The geology of the Study Area is typical of the North Coast Physiographic Province. Rocks of the Franciscan Assemblage (graywacke sandstone, chert, and serpentinite) have been highly sheared and faulted due to mountain-building processes that have occurred in the area. This mountain-building process has developed a northwest-southeast structural trend, which the major topographic features tend to follow. Generally, the entire Study Area is situated on one of these trending structures.

TABLE 6

AMBIENT SOUND LEVELS AT RECEPTOR SITES IN THE VICINITY OF THE PROPOSED NCPA/SHELL GEOTHERMAL POWER PLANT [a]

Location	Date	Time	Sound Level dBA (ref. 20 micropascal)	Comments
1	3-20-73	1435	41	Light rain, creek noise
	10-04-73	2220	42	Fair weather, insect noise
	10-05-73	0815	43	Fair weather, distant steam noise barely audible
	11-27-73	1504	38	Foggy, creek noise
	12-01-75	2025	41	Natural sounds
	12-02-75	1520	42	Natural sounds
2	3-20-73	1550	55	Creek noise
	10-04-73	2230	42	Creek noise
	10-05-73	0817	44	Creek noise, distant steam noise barely audible
3	3-20-73	1605	53	Light rain and wind, creek noise
	10-04-73	2245	48	Distant steam noise barely audible
	10-05-73	0820	49	Distant steam noise barely audible
4	3-20-73	1620	38	Light rain and wind
	11-27-73	1700	30-32	Foggy, natural sounds, distant steam noise barely audible
	11-28-73	0840	34-36	Fair weather, natural sounds
	12-01-75	1620	40	Natural sounds
5	10-05-73	0825	43	Fair weather, distant steam noise barely audible
	11-28-73	0830	47	Fair weather, creek noise
	12-01-75	1515	40-45	Natural sounds
	12-02-75	0805	37	Natural sounds
6	11-27-73	1545	34	Foggy, natural sounds, steam noise audible
7	1-16-76	1700	33-35	Natural sounds
8	12-01-75	2017	29-34	Natural sounds
9	12-01-75	1700	45-50	Bleed line noise from capped well audible
11	11-17-76	1710	26	Distant traffic; birds
	11-18-76	0150	34	Insects
	11-18-76	1400	24-25	Distant hum, flies, birds
12	11-17-76	1950	35	Insects, distant traffic
	11-18-76	0215	28	Distant running water
	11-18-76	1435	27-28	Birds, distant running water, flies
13	11-17-76	2010	39	Insects, distant traffic
	11-18-76	0230	20	- - -
	11-18-76	1515	27	Distant traffic, birds, distant sawing
14	11-17-76	2030	51	Running water
	11-18-76	0245	36	Running water
	11-18-76	1540	39	Running water, insects, distant children
15	4-08-77	1610	34	No wind or animal sounds
16	4-24-77	1910	36	Some wind gusts
17	4-24-77	1845	39	Some wind gusts
18	1-28-78	1045	36	Drilling noise at 1 mile clearly audible
19	1-28-78	1630	36	Creek noise in distance, frogs

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[a] All measurements are based on direct observations of hand held sound level meters during quiet ambient conditions.

Sources:

1973 measurements from Table 13, P.G. & E. Environmental Data Statement, Geysers Unit 13, March 1975.

December 1 & 2, 1975 and January 16, 1976 measurements from Table V-9, P. G. & E. Environmental Data Statement, Geysers Unit 16, August 1977.

November 17 & 18, 1976 measurements from Table 1, Appendix D, Long Ridge Geothermal Leasehold Draft EIR, Environmental Impact Planning Corp., April 1977.

1977 and 1978 measurements from Table V-69, Draft EIR for Thermogenics, Inc., Klau Mine Leasehold Expansion Project, ECOVIEW Environmental Consultants, April 1978.

Instrumentation:

Measurements on 3-20-73 were made with a General Radio, Type 1558-BP Octave Band Analyzer set to A-Weighting with a one inch ceramic microphone and associated preamplifier. This instrument meets or exceeds the requirements for Type 2-General Purpose Sound Level Meters established in ANSI S1.4-1971. Acoustical calibration performed in the field with a General Radio, Type 1562-A, Sound Level Calibrator.

Measurements on 10-4-73, 10-5-73, 11-27-73 and 11-28-73 were made with a General Radio, Type 1933 Precision Sound Level Meter with a half-inch Electret-Condenser Microphone. This instrument meets the requirements for Type 1-Precision Sound Level Meters established in ANSI S1.4-1971. Acoustical calibration performed in the field with a General Radio, Type 1562-A, Sound Level Calibrator.

Measurements on 12-1-75, 12-2-75, and 1-16-76 were made with instruments that meet or exceed Type II specifications per ANSI S1.4-1971. Acoustical calibration performed in the field with a General Radio, Type 1562-A, Sound Level Calibrator.

Measurements on 11-17-76 and 11-18-76 were made with a Bruel & Kjaer Type 2203 Precision Sound Level Meter with B & K Type 4131 microphone and windscreen. B & K Type 4220 Pistonphone Calibrator used in the field.

Measurements in 1977 and 1978 were made with a Bruel & Kjaer Type 2209 Precision Sound Level Meter equipped with a half-inch B & K Type 4133 Condenser Microphone. Acoustical calibration performed in the field with a B & K Type 4230 Sound Level Calibrator.

*Source: NCPA Geothermal Project No. 2, Vol. 2, No. I

Geologic Hazards

Seismic Activity

Historically, The Geysers area has been seismically very active. However, this activity has been of very low magnitude. An experiment conducted at The Geysers by the U.S. Geological Survey during a 3-week period in 1971 revealed 53 microearthquakes along a zone 2.5 miles long and .6 mile wide. Richter magnitudes generally were below 1.5. This is similar to data reported from other undeveloped geothermal fields throughout the world (Kenya, Iceland, El Savador) (Nielson et al. 1975). The Study Area is situated near the Mercuryville fault zone which may form the southern boundary of The Geysers steam field.

Landsliding

Slope instability and landsliding are very common throughout The Geysers area. The steep slopes, high rainfall, inherently weak nature of the sheared and faulted rocks, and the presence of melange structure make these areas highly susceptible to earth and rock movement in the form of slope failures.

For the purpose of this environmental assessment, a landslide survey was made using stereo-paired air photos and surfacial geologic maps of the U.S. Geological Survey (McLaughlin 1974). No attempt was made to identify all landslide features present, only those readily identifiable on the maps and air photos. Likewise, no attempt was made to classify the landslides as to age, depth, identification reliability, or type of movement (Map 5).

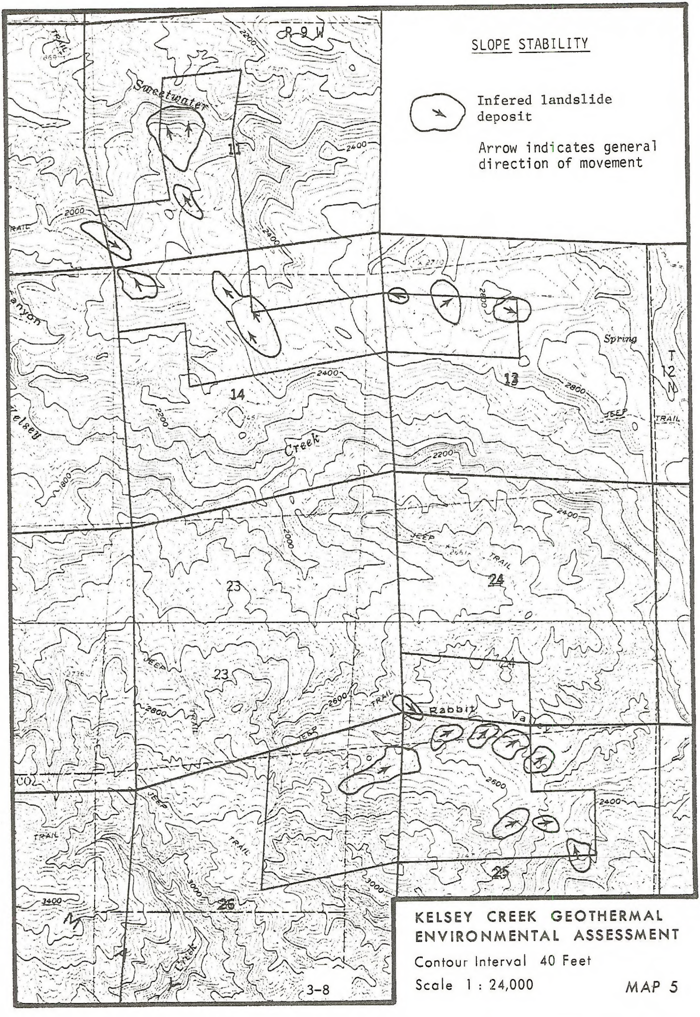
SOILS

The soils in the Study Area lie on steep to gently rolling west to northwest trending ridges with slopes up to 75 percent. For the most part, the soils are loams and gravelly loams that are shallow over bedrock. Parent materials are mostly a weathered sandstone, shale, and serpentine rock.

Generally, the soils are low in fertility with nitrogen the most limiting factor. The serpentine soils (Henneke, Montara) are very deficient in nitrogen, phosphorus, and calcium and moderately deficient in sulphur, molybdenum, and potassium (Jones, Vaughn, and Harris 1976). Because of the poor physical and chemical properties, it is difficult to re-establish vegetation on serpentinitic soils disturbed by construction activities.

Infiltration into most of the soils is very slow, available water capacity is low, and a high rate of water runoff can be anticipated.

Present erosion of the area is moderate to high depending primarily on soil type, slope, and vegetation. Erosion on much of the Henderson tract is moderate because slopes are gentle, and Sargent Cypress forms a good cover. The erosion hazard, if the vegetation is disturbed, will be high to very high, especially on slopes over 15 percent. Erosion hazard ratings along with other



SLOPE STABILITY

Infered landslide deposit

Arrow indicates general direction of movement

KELSEY CREEK GEOTHERMAL ENVIRONMENTAL ASSESSMENT

Contour Interval 40 Feet

Scale 1 : 24,000

MAP 5

soil characteristics for each soil series are shown in Table 7. The soils have been mapped by the Soil Conservation Service as shown on Map 6. These are only preliminary maps, so there may be changes before final publication.

VEGETATION

General Vegeatation

The Study Area has been typed into eight plant communities, six of which are shown on Map 7. The distribution of these communities reflects various site factors such as slope aspect (direction), elevation, substrate (parent rock and soil type), steepness and stability of slopes, and moisture (Comarc Design Systems 1975).

The Henderson tract presents a nearly uniform expanse of serpentine chaparral. Only in two areas is this uniformity broken: (1) along the border of Sweetwater Creek where some riparian vegetation is found but where species composition is severely limited because of the serpentine substrate and (2) at the southwestern corner of the tract where grassland and chamise chaparral occur in response to non-serpentine soils.

The greater number of plant communities found on the Binkley tract reflect the more varied soils and topography of that area.

Because plant communities often intergrade with each other or occur in isolated patches too small to map with the scale used, the vegetation map shows approximate boundaries and indicates the most common plant community or communities within a given area. For instance, the small, widely scattered stands of knobcone pine forest that occur on the Binkley tract are not mapped as separate units but are included within the adjacent mixed chaparral or mixed evergreen forest communities. The continuous brush cover on the south-facing slope of the main mountain ridge in the same tract is mapped as one vegetational unit, even though it is composed of chamise chaparral in the drier, hotter sites and mixed chaparral dotted with occasional stands of knobcone pine in the more moist sites.

The approximate acreages for the major communities are: grassland, 30; chamise chaparral, 137; mixed chaparral, 108; serpentine chaparral, 494; mixed evergreen forest, 94; and knobcone pine forest, 39.

Sensitive Species

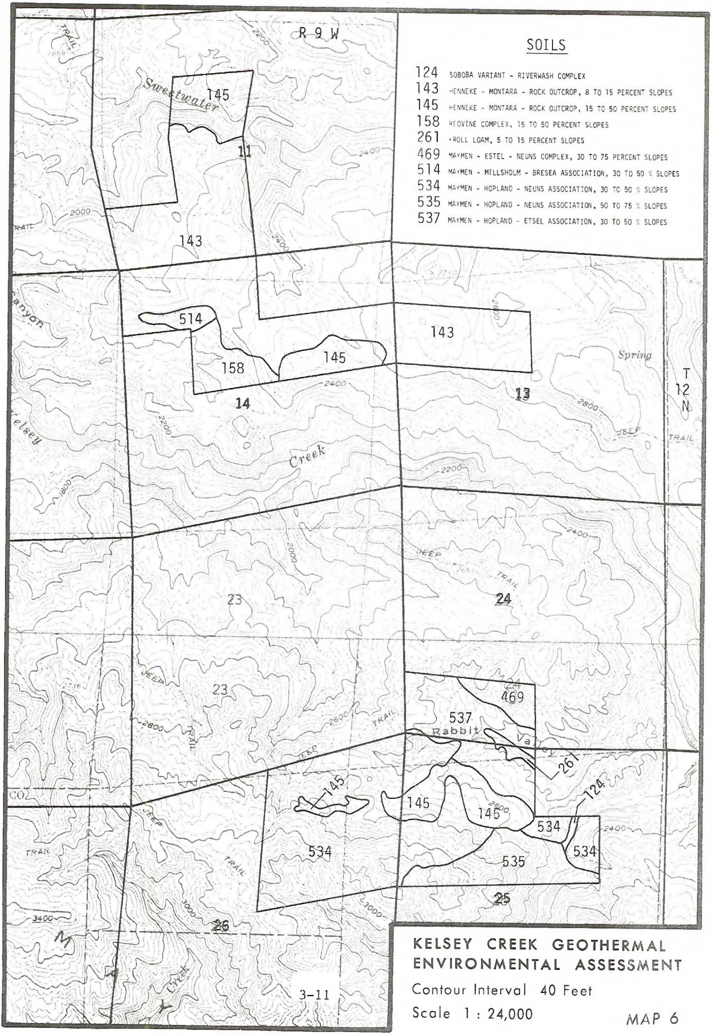
A review of Federal, State, and California Native Plant Society (CNPS) lists indicates that thirty-seven sensitive species of plants may occur within a 5-mile radius of the study area. Appendix A lists these species along with other pertinent data. Information concerning these species was obtained from field surveys, literature searches, CNPS, California Department of Fish and Game, and several specialists familiar with the vegetation of the region.

Because of the timing of the pre-lease inventories - November and December 1979 - the presence or absence of sensitive species within the Study Area

TABLE 7

SOIL CHARACTERISTICS

Soil	Texture	Slope (Percent)	Erosion	Fertility	Bedrock (In.)	Revegetation Problems	Available Topsoil Material (In.)
Maymen	Loam	30-75	High	Very low	10-20	Very high	None
Henneke	Gravelly Loam	15-50	High to very high	Very low	12-20	Extremely high	None
Hopland	Loam	30-75	High	Moderate low	25-38	High	Good to 16 inches
Montara	Clay Loam	15-50	High	Very low	12	Extremely high	None
Etsel	Gravelly Loam	30-75	High	Very low	4-10	Extremely high	None
Neums	Gravelly Loam	30-75	High	Low	30-35	High	None
Kroll	Loam	5-15	Moderate	Moderate	60	Slight	Good to 35 inches
Redvine	Loam	15-50	Moderate high	Low	60 +	Moderate	None
Millsholm	Loam	30-50	High	Very low	10-20	High	None
Bressa	Loam	30-50	Moderate to high	Low	20-40	Moderate	Fair to 12 inches
Soboba	Very gravelly sandy loam	0-2	High	Low	---	High	None



SOILS

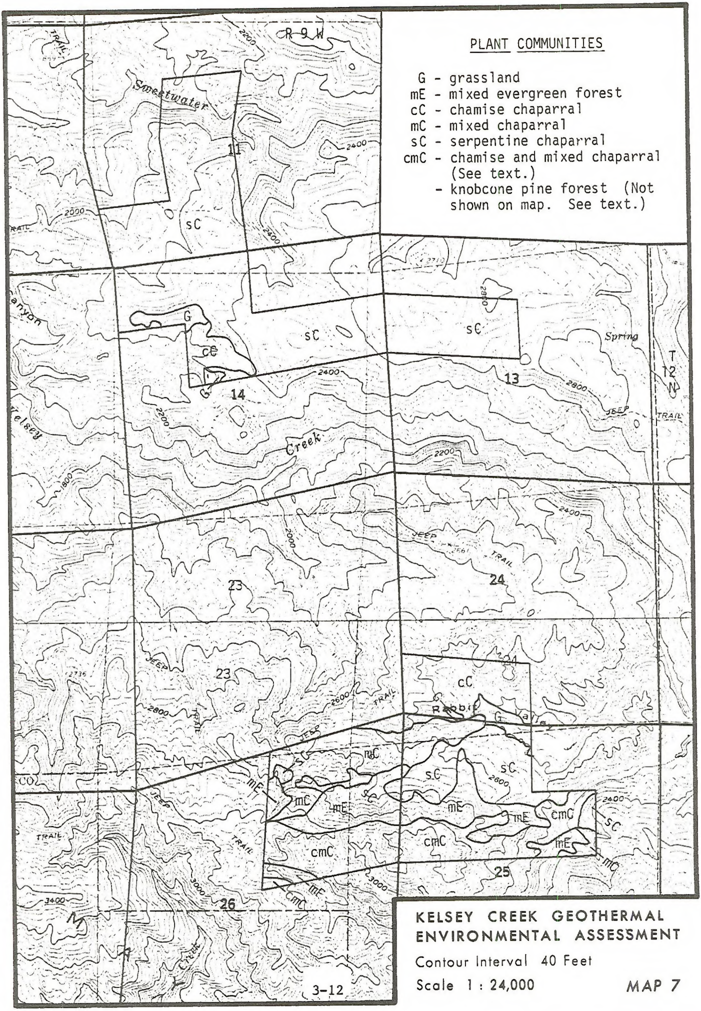
124	SOBOBA VARIANT - RIVERWASH COMPLEX
143	HENNEKE - MONTARA - ROCK OUTCROP, 8 TO 15 PERCENT SLOPES
145	HENNEKE - MONTARA - ROCK OUTCROP, 15 TO 50 PERCENT SLOPES
158	REOVINE COMPLEX, 15 TO 50 PERCENT SLOPES
261	ROLL LOAM, 5 TO 15 PERCENT SLOPES
469	MAYMEN - ESTEL - NEUNS COMPLEX, 30 TO 75 PERCENT SLOPES
514	MAYMEN - MILLSHOLM - BRESEA ASSOCIATION, 30 TO 50 % SLOPES
534	MAYMEN - HOPLANO - NEUNS ASSOCIATION, 30 TO 50 % SLOPES
535	MAYMEN - HOPLAND - NEUNS ASSOCIATION, 50 TO 75 % SLOPES
537	MAYMEN - HOPLAND - ETSEL ASSOCIATION, 30 TO 50 % SLOPES

KELSEY CREEK GEOTHERMAL ENVIRONMENTAL ASSESSMENT

Contour Interval 40 Feet

Scale 1 : 24,000

MAP 6



PLANT COMMUNITIES

G - grassland
mE - mixed evergreen forest
cC - chamise chaparral
mC - mixed chaparral
sC - serpentine chaparral
cmC - chamise and mixed chaparral (See text.)
- knobcone pine forest (Not shown on map. See text.)

KELSEY CREEK GEOTHERMAL ENVIRONMENTAL ASSESSMENT

Contour Interval 40 Feet

Scale 1 : 24,000

MAP 7

could not be fully determined. However, three populations of *Streptanthus* were discovered (Map 8). Since only very small seedlings and remnants of mature plants were present, it is likely that these are populations of annual species. The sensitive species or taxa in the *Streptanthus morrisonii - brachiatus* complex are biennial. However, definitive identification of these populations should be made in the early spring.

Occurrence of additional populations of *Streptanthus*, as well as populations of other listed serpentine endemics, is likely because of the extensive distribution of serpentine soils. The greatest likelihood is in those serpentine areas that are sparsely vegetated, that is, most closely approximate the conditions of barrens.

Those portions of the grasslands that are wet in the spring also offer high potential as habitat for sensitive species and are indicated on Map 8.

Plant Communities

Three different chaparral communities are recognized on the Study Area site.

Chamise Chaparral

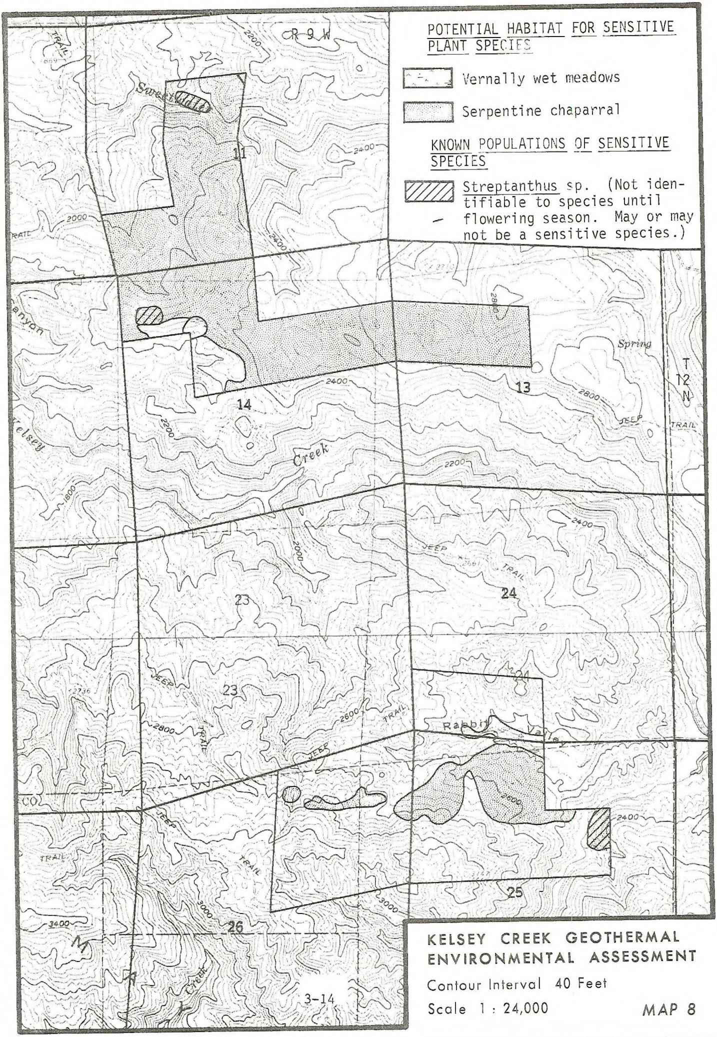
Approximately 3 to 6 feet tall, chamise chaparral is a shrub type with chamise and buckthorn as codominants and without an understory. It occurs throughout the Study Area in the hottest and driest sites, such as south and west-facing slopes and exposed ridges.

Mixed Chaparral

This type of chaparral forms a dense thicket of many woody shrub species. It occurs on northerly slopes on sites wetter than those occupied by chamise chaparral. It is usually above the chamise in elevation. Locally, manzanita or scrub oak may dominate a stand.

Serpentine Chaparral and Serpentine Barrens

Serpentine chaparral presents a special case in plant nutrition since most plants are intolerant to the low calcium levels of serpentine soils (Walker 1954). It has been proposed that serpentine endemics have the ability to obtain sufficient calcium as well as tolerate one or more of the following: high concentrations of chromium and nickel, high magnesium, low levels of major nutrients, low available molybdenum, and the drought and other undersirable aspects of shallow, stony soils (Walker et al. 1955). *Quercus durata, Ceanothus jepsonii,* and *Cupressus sargentii* are considered indicator species because of their typical restriction to and numerical dominance on serpentine soils.


POTENTIAL HABITAT FOR SENSITIVE PLANT SPECIES
Vernally wet meadows
Serpentine chaparral
KNOWN POPULATIONS OF SENSITIVE SPECIES
Streptanthus sp. (Not identifiable to species until flowering season. May or may not be a sensitive species.)
R 9 W
T 12 N
Sweet Water
Canyon
Kelsey
Creek
Spring
Rabbit Valley
JEEP TRAIL
TRAIL
CO
11
13
14
23
24
25
26
2000
2200
2400
2600
2800
3000
3400

KELSEY CREEK GEOTHERMAL ENVIRONMENTAL ASSESSMENT

Contour Interval 40 Feet

Scale 1 : 24,000

MAP 8

In this Study Area, serpentine barrens are included within the plant community serpentine chaparral, although the association of plants that provide the sparse vegetation of a barren is somewhat different than that found on serpentine chaparral. Widely scattered individuals of the same indicator species mentioned above may occur. Digger pine may also be present. The general aspect, however, is one of bare rocky talus. The few species adapted to function within the harsh conditions created by the high degree of serpentinization present in barrens' soil are inconspicuous and well camouflaged. Adaptive features prevent large water losses and enable the plant to obtain and store nutrients and water.

Consequently, many of the species that are adapted to the unique set of environmental conditions found on serpentine barrens are highly specialized and restricted to the habitat that in itself is generally limited in distribution. As a result, these serpentine endemics tend to be sensitive species, requiring special evaluation and protection.

Grassland

Introduced annual grasses such as *Bromus, Avena,* and *Festuca* have largely replaced the native perennial bunch grasses that originally composed the California grasslands.

The introduced grasses form stands varying in degree of cover from sparse to dense, and in height from a few inches to about 3 feet. These variations in cover and height are directly related to available moisture, soil type, and soil condition, which depend upon current and past use. In spring, when soil moisture is available, extensive, colorful blooms of annuals, such as California poppies and goldfields, and perennials, such as lupine, occur in grasslands.

Seeps, springs, and vernally wet areas in grasslands support distinctive floras, frequently with sensitive species.

Grasslands are frequently found adjacent to and intergrading with the different chaparrals and woodlands.

Riparian Woodland

Restricted to areas with an abundant and perennial water supply, riparian woodlands parallel canyon bottoms and other drainage channels. They form narrow ribbons of distinctively moist vegetation that contrast markedly with much of the vegetation in the region, particularly with the various chaparral types.

The tree story forms an open canopy. It is composed of deciduous broad-leaved trees, such as alder and maple, while willows and gooseberries are among the great variety of species that make up the shrub layer. Vines, ferns, and herbs are also common, contributing to the dense ground cover. Such a complex community structure provides a diversity of habitats and niches of exceptional botanical and wildlife value.

Within the Study Area, well-developed riparian woodland occurs only along a small portion of High Valley Creek.

Along Sweetwater Creek, riparian vegetation is represented primarily by western azalea with occasional willow and bay trees. The large size of the Sargent Cypress bordering the Creek is also a response to the availability of water. Most riparian species, however, are absent, apparently intolerant of the serpentine substrate.

Knobcone Pine Forest

Knobcone pine forest occurs in localized stands in both serpentine and non-serpentine soils. Since their cones open in response to the heat of fire, knobcones are particularly common on burned-over lands. Pure stands as well as stands with a shrub understory occur within the Study Area.

Mixed Evergreen Forest

Mixed evergreen forest is a broad vegetational category that includes several different phases, or groupings, of species within its range. It generally occupies northerly, wet sites in major canyons and drainages and forms a dense canopy, often with a shrub understory. The proportion of broad-leaved to coniferous species reflects changes in elevation as well as other factors, such as frequency of fire and avilability of misture.

The mixed hardwood phase is an association of madrone, tanbark oak, laurel, and oaks with Douglas-fir absent. Manzanita, deer brush, and coffeeberry are often present as a shrub understory.

In its most highly developed climax phase, mixed evergreen forest is dominated by Douglas-fir with little understory.

Vernal Pools

Vernal pools cover an extremely small portion of the total area of the State, certainly less than one percent. Consequently, many of the plants that are adapted to the special environment of a vernal pool are rare endemics and therefore sensitive species. Fifty-five of the 110 species that occur typically in vernal pools have ranges limited entirely within California, 14 extend barely beyond the State boundaries, and 18 are limited to western North America.

Most often vernal pools occur in grasslands but they may be found in other plant communities.

Since areas that are moist in the spring, such as the Rabbit Valley meadow and portions of the small grassland in the NE¼ of Section 14 of the Henderson tract, share certain characteristics of vernal pools, they may also provide habitat for some of the same sensitive species.

During the pre-lease inventory no vernal pools were found within the Study Area. However, any vernal pools found during site-specific surveys should be carefully examined for the presence of sensitive species, particularly those that occur at nearby Boggs Lake.

WILDLIFE

Terrestrial Wildlife

Habitats

The natural condition of the Kelsey Creek Study Area has been altered to a moderate degree by past disturbance. Road and trail networks are present on both of the land parcels and a dwelling is on the Binkley property.

Eight vegetation types have been identified in the Study Area. Wildlife species associated with major types are well documented in "The Geysers Wildlife Study" (1977). Additional information by habitat type is contained in the "NCPA, Notice of Intent" (SAI Engineers 1978). Table 8 shows the relative sensitivity to disturbance and importance of vegetative types of terrestrial wildlife, and Map 9 the Wildlife Sensitive Areas.

Chaparral Vegetation. Chaparral dominates the Study Area. Brush is a major vegetation type in California. In pure stands and mixed with other vegetation, it covers nearly one-quarter of the State (Adams 1978). Although numerous species of wildlife occur in chaparral, relatively few species seem to be adapted to extensive stands of mature chaparral. However, many species thrive in younger chaparral stands, particularly if there are openings with grass and herbaceous plants present (Longhurst 1978).

Serpentine chaparral makes up a large part of the chaparral type in the Study Area. Serpentine chaparral is generally considered to have lower habitat values than chamise or mixed chaparral.

Portions of the Henderson parcel have well-developed stands of mature Sargents cypress. The high degree of decadence and the arboreal features provide habitat values rarely found in serpentine areas. Cavity nesting birds, and animals that utilize litter for cover (such as various snakes, shrews, and amphibians) would be expected to utilize this area.

Riparian Vegetation and Streamside Zones. Riparian zones, because of their plant species and physical diversity and presence of water, comprise the most valuable wildlife habitat per unit area within the Study Area. These areas are absolutely essential for aquatic forms and are used to varying degrees by a greater variety of wildlife species than any other habitat type (Pacific Gas & Electric 1977). Numerous wildlife species associated with the other habitat types remain obligated to the riparian zone, particularly for drinking water but also for cover and food. In addition, the riparian zones are most sensitive to disturbances (Comarc Design Systems 1975).

TABLE 8

Sensitivity to Disturbance and Importance of Kelsey Creek Habitats for Terrestrial Wildlife 1/

	Riparian 2/	Mixed Evergreen Forest	Oak Woodland	Yellow Pine (stand)	Mixed Chaparral	Chamise Chaparral	Grassland (annual)	Serpentine Chaparral	Knobcone Pine (forest)
Relative Values	High	High	Med.	Med.	Med.	Low	Low	Low	Low

More Sensitive - Important to Less Sensitive - Important

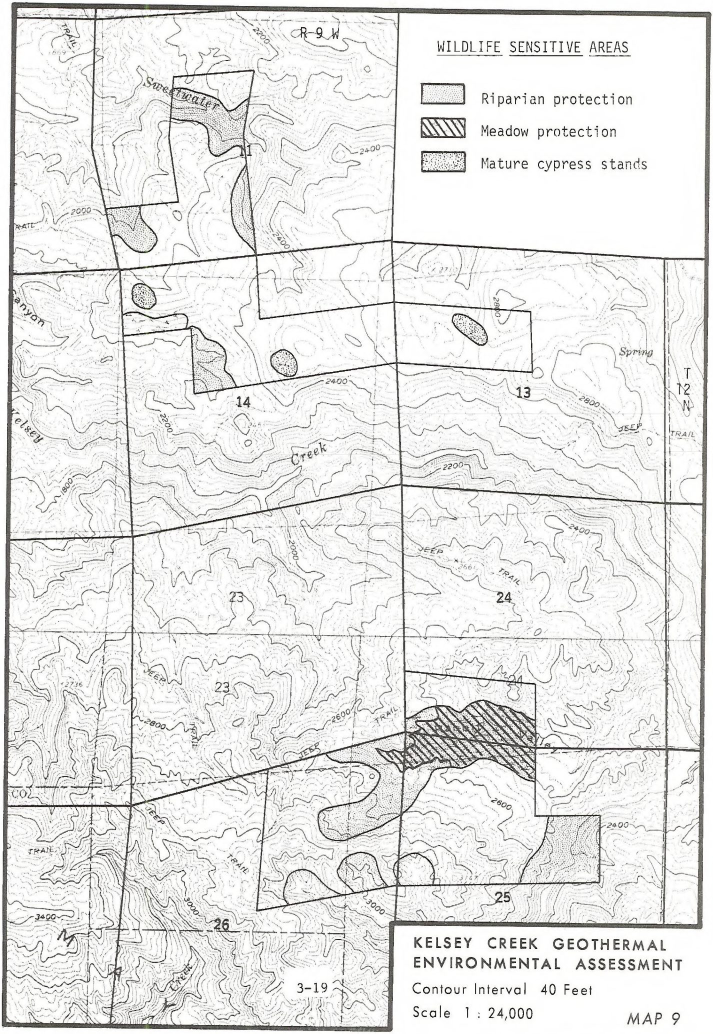
The following considerations and assumptions were used in ranking habitats;

a. Present condition of vegetation.
b. Complexity of special habitat features provided for wildlife.
c. Overall size and availability relative to (b) above.
d. Human disturbance past and present.
e. Ability to recover following disturbance.

Pertinent literature including "The Geysers Wildlife Study - Interim Report" 1977 and Comarc Design Systems 1975.

1/ Habitat value is increased where two or more vegetation types meet.

2/ Riparian habitat and water areas including creeks, seeps, springs, ponds, and vernal pools greatly increase the value of all other habitats in which they occur.



WILDLIFE SENSITIVE AREAS

░ Riparian protection

▨ Meadow protection

▒ Mature cypress stands

KELSEY CREEK GEOTHERMAL ENVIRONMENTAL ASSESSMENT

Contour Interval 40 Feet

Scale 1 : 24,000

MAP 9

A very high-quality riparian zone exists in the Kelsey Creek drainage just east of the Binkley property. The fall acorn crop attracts a large population of deer. Acorns and other mast also attract flocks of bandtailed pigeons. High Valley and Rabbit Valley creeks, both on the Binkley parcel, also exhibit high habitat values for a diverse fauna.

Mixed Evergreen Forest. The better-developed and most important mixed evergreen woodland in the Kelsey Creek Study Area occurs primarily on the north slopes. This vegetation or habitat type achieves its highest development on the north-facing slope above Rabbit Valley. With the exception of several poorly developed roads, this area is relatively undisturbed. Another important area of mixed-evergreen vegetation occurs in the High Valley Creek and Sweetwater Creek drainages.

The mixed evergreen vegetation ranks high in plant structure diversity and therefore provides habitat requirements for a variety of wildlife. Oaks, especially the black oak, madrone, *Ceanothus*, and *Rhamnus*, provide food for numerous wildlife. In addition to knobcone pine, a few Douglas-firs and ponderosa pines are present. The large conifers and conifer snags supply important food, cover, and nesting sites for numerous cavity users. A partial list of animals that use cavities found in the larger conifers and oaks include several species of owls, woodpeckers, flycatchers, swallows, gray-squirrel, ring-tailed cat, and raccoon. Extremely long periods of time are required for the development of the larger conifers and oaks.

Of particular importance to wildlife are areas where the mixed evergreen and riparian vegetation extend into one another resulting in a continuum of complex and highly desirable wildlife habitat. Such an important and complex area occurs in High Valley and Sweetwater creeks.

Grasslands (Annual). California annual grasslands provide forage for deer during late winter and spring. A variety of burrowing rodents, other small mammals, and granivorous birds are also present. Although small in area, the low-growing vegetation provides desirable foraging areas for several raptors. Meadow areas are also valuable as deer fawning areas. Several small areas of grasslands are found in the southwestern portion of the Henderson parcel. The most important area of this type is found in Rabbit Valley. The perennial stream in Rabbit Valley greatly increases its habitat value. Any wet areas encountered in meadows are important to wildlife and are sensitive to disturbance.

Knobcone Pine Forest. The knobcone pine forest is relatively dense and even-aged and provides little habitat diversity. These areas provide important structural diversity along their edges and where they occur in small pockets within other vegetation types. The knobcone pine is adapted to disturbance (fire) but requires a long period of time for development.

Endangered and Protected Species

Peregrine Falcon *(Falco peregrinus)*. Helicopter surveys conducted during Spring 1979 revealed no active nest sites in or next to the Study Area. A historic site has been reported outside the area but in the general vicinity.

Although some foraging activity is likely, the U.S. Fish and Wildlife Service has concluded that geothermal development would not jeopardize the continued existence of the peregrine falcon (Martinson 1979). Foraging by the peregrine falcon would most likely occur along the major drainages in riparian and adjacent mixed evergreen vegetation types (Map 7).

Golden Eagle *(Aquila chrysaetos)*. No golden eagle nesting sites were observed in the area during the 1979 peregrine nesting surveys. Golden eagle sightings have been reported throughout The Geysers KGRA (Pacific Gas & Electric 1977 and Stager and Proby 1979). While no known observations of the golden eagle have occurred within the Study Area, periodic use of the area for feeding is likely. Potential foraging areas include the more open vegetation types, such as serpentine chaparral, grassland, and open area within other types.

Ring-tailed Cat *(Bassariscus astutus)*. Presence of the ring-tailed cat is anticipated but not yet confirmed. This animal would most likely occur in rocky outcrops along permanent waterways. Areas where creeks pass through evergreen woodland and mixed chaparral would be most preferred by the ring-tailed cat.

Game Species

Major game species include the black-tailed mule deer *(Odocoileus hemionus columbianus)*, western grey squirrel *(Sciurus griseus)*, mountain quail *(Oreortyx pictus)*, California quail *(Lophortyx californicus)*, mourning dove *(Zenaidura macroura)*, and band tailed pigeon *(Columba fasciata)*.

Black-tailed deer are quite common and widespread throughout the area. Preferred use areas generally include areas of lower plant succession within most habitats, particularly the chaparral types adjacent to mixed evergreen and oak woodlands.

The grey squirrel concentrates in the mixed evergreen type but also occurs in lower numbers in knobcone pine forest.

California quail are associated with drainageways and prefer oak and evergreen woodlands and mixed chaparral.

Mountain quail habitat includes the mixed chaparral and evergreen vegetation types.

Doves, being highly mobile, are ubiquitous in the Study Area. Preferred areas for feeding include the sparser serpentine vegetation types and open areas within other types. Nesting and watering generally occur in riparian areas and mixed evergreen woodland.

Band tailed pigeons occasionally forage in the mixed evergreen, oak, and riparian areas.

Small Mammals

At least 14 species of small mammals and several species of bats are expected to occur in the Kelsey Creek area (Pacific Gas & Electric 1977). Most common are three species of white-footed mice *(Peromyscus)*, the dusky-footed woodrat *(Neotoma fuscipes)*, black-tailed hare *(Lepus californicus)*, and brush rabbit *(Sylvilagus bachmani)*. These species comprise the major prey of such predators as the coyote *(Canis latrans)*, gray fox *(Urocyon cinereoargenteus)* and bobcat *(Lynx rufus)*. The red-tailed hawk *(Buteo jamaincensis)* and the golden eagle also depend on these small mammals for food.

The small mammals achieve their greatest abundance in chaparral, mixed evergreen, and riparian habitats.

Birds

Preliminary data indicates that at least 65 species of birds may occur in the Area. Additional species are expected to occur seasonally. Overall, the riparian habitat is most important for birds. Other valuable habitats include mixed chaparral and evergreen types. Songbirds serve as prey for raptors including the sharp-shinned hawk *(Accipiter striatus)* and Coopers hawk *(Accipiter cooperi)*. Minor foraging by the prairie falcon *(Falco mexicannus)* could occur in the Area, but no nesting sites were located during raptor surveys.

Reptiles

Approximately 14 species of reptiles occur primarily in the terrestrial habitat. The two most common species are the western fence lizard *(Sceloporous occidentalis)* and the sagebrush lizard *(Sceloporous graciosus)*.

Insects

Information on the insect species that may occur is available in a study conducted by Comarc Design Systems (1975).

Aquatic Wildlife

No rare or endangered fish species are known to occur within the Study Area. On-site fishery resources are located in about ½ mile of High Valley Creek and 1/3 mile of Sweetwater Creek. Fish species include rainbow and brown trout in High Valley Creek and rainbow trout and western roach in Sweetwater Creek. Both of these stream sections drain into Kelsey Creek within one mile and thence into Clear Lake.

PALEONTOLOGY

Several fossil localities were identified in the immediate vicinity of the Study Area. However, due to the widespread, worldwide occurrence of radiolarian and foraminifera remains, these localities and others like them could not be considered a significant discovery. They would be useful mainly from a standpoint of age correlation or scientific curiosity. Technically, such fossilization would be considered "common invertebrate fossil remains."

The possibility exists that significant fossilization could occur in the Area. Several unverified reports of unique fossils found in the Fransciscan Assemblage are in literature. But, in general, chances of such a discovery are considered very remote.

VISUAL RESOURCES

Landscape Character

The characteristic landscape is determined by the features that are seen and their arrangement in the landscape. These landscape features are landform/water, vegetation, and structure. The character is described in terms of the four basic visual elements: form, line, color and texture. Although all four elements are present in every landscape, they exert varying degrees of influence; the stronger the influence, the more interesting the landscape. The more visual variety in a landscape, the more aesthetically pleasing the landscape. Variety without harmony, however, is unattractive, especially in terms of alterations/cultural modifications that are made without care.

The proposed Kelsey Creek Lease Area lies within the "Low Coastal Mountains" landscape province. The landform is characterized by steep rolling hills, dissected by sharply defined drainage patterns. Ridgelines are irregular and rounded, and appear in undulating series below the horizon. In the drainages, the lines converge sharply and at lower elevations become drawn out and smoother along the axis of valley bottoms. Colors are muted ranging from tans to gray-greens and accentuate the landform with shadows. The texture blends from moderate to coarse grained over the smooth landforms.

The vegetation is composed of a mosaic pattern of mixed chaparral species interspersed with conifers of the north and east slopes. The drainages are accentuated with riparian species on hardwoods and conifers. The overall texture is fairly uniform with moderate grain, however at vegetative changes there is a stronger vertical dominance. The texture becomes more coarse in the conifers and hardwoods. The background colors are dominated by muted grey-greens with patches of golden tans. The foreground varies with seasonal changes from bright greens and yellowish greens to the grey-greens and tans.

Presently, this Area has few cultural modifications. These include isolated ranches and homes with the associated roads and utilities. The effect of the intrusions is minimal; however as geothermal development expands into this area, land use patterns will change with added intrusions noticeable in the landscape. Currently, the Kelsey Creek Mineral Reserve Lease Area is surrounded by public land previously leased for geothermal development. However, actual exploration and resource development have been limited to date.

Scenic Quality

Scenic quality ratings are based on inventories and evaluations of the seven key factors that comprise the visual landscape and determine its relative visual importance. These factors are landform/vegetation, water, color; adjacent scenery; scarcity; and cultural modifications.

In accordance with the Visual Resource Management (VRM) Program, the Kelsey Creek Study Area has been inventoried and evaluated. Due to the landform relief, vegetative variety, adjacent scenery, and the lack of existing cultural modifications, the Area is rated as a Class B landscape. The Class B rating identifies areas in which there is a combination of some outstanding landscape features and some that are fairly common to the physiographic region.

Sensitivity and Distance Zones

Although landscapes do have common elements that can be measured, there is obviously still a subjective dimension to landscape aesthetics. Each viewer brings perceptions formed by individual influences: culture, visual training, familiarity with local geography, personal values. To measure visual sensitivity towards the landscape, regional and individual attitudes are evaluated. Use volume, frequency of travel or use, and user reactions to change in the landscape are the basis of sensitivity ratings. The visual quality of a landscape and sensitivity to it may be magnified or diminished based on visibility and viewing distance.

The Kelsey Creek Study Area lies entirely outside the historical Geysers Basin. Visibility is greater and sensitivity higher due to its proximity to urbanized, residential, and resort areas. There is also a greater network of public travel routes that afford views of the Study Area. One such route is Bottlerock Road which has been identified in the Lake County General Plan as a scenic highway. Bottlerock Road is used primarily for local and seasonal resort traffic between Kelseyville and Cobb Village. Seasonal weekday traffic counts in 1977 indicated 1160 ADT coverage daily trips and is projected at 1550 ADT by 1985. State Route 29 is the major north/south travel corridor within the County, and reaches a traffic level of 5600 ADT between Lakeport and Kelseyville.

The Binkley Tract portion of the proposed Kelsey Creek lease area lies within the Bottlerock Road viewshed. Viewpoints along Bottlerock Road are as close as two miles, affording foreground/middleground views. Portions of the higher elevations and ridgetops are also seen in the background from vistas along State Route 29 between Lakeport and Kelseyville. For the volume and type of use of these travel routes, the highly visible areas are rated as having a high level of sensitivity. The upper elevations of the Henderson Tract are periodically visible from the Big Valley area. Sensitivity for these areas is moderate. For the rest of the Study Area, the sensitivity level is low to moderate based on various low-use, localized roads and visibility.

Management Classes

Visual resource management classes are management objectives that describe different degrees of modification allowed to the basic elements of the landscape. These class designations are based on evaluation of scenic quality, sensitivity levels, and distance zones.

The Geysers Basin and adjacent lands with the potential for geothermal development have previously been identified as interim Class III management areas until thorough inventories and evaluation can be completed.

In response to the Kelsey Creek lease proposal, the Study Area has been inventoried and evaluated in order to establish management classes. The results indicate that for most of the Study Area, the Class III management objectives are appropriate. However, due to visibility and high sensitivity, a portion of the Study Area should be managed as a Class II. These areas are delineated on Map 10.

The following descriptions are for the management classes applicable to the Kelsey Creek Study Area.

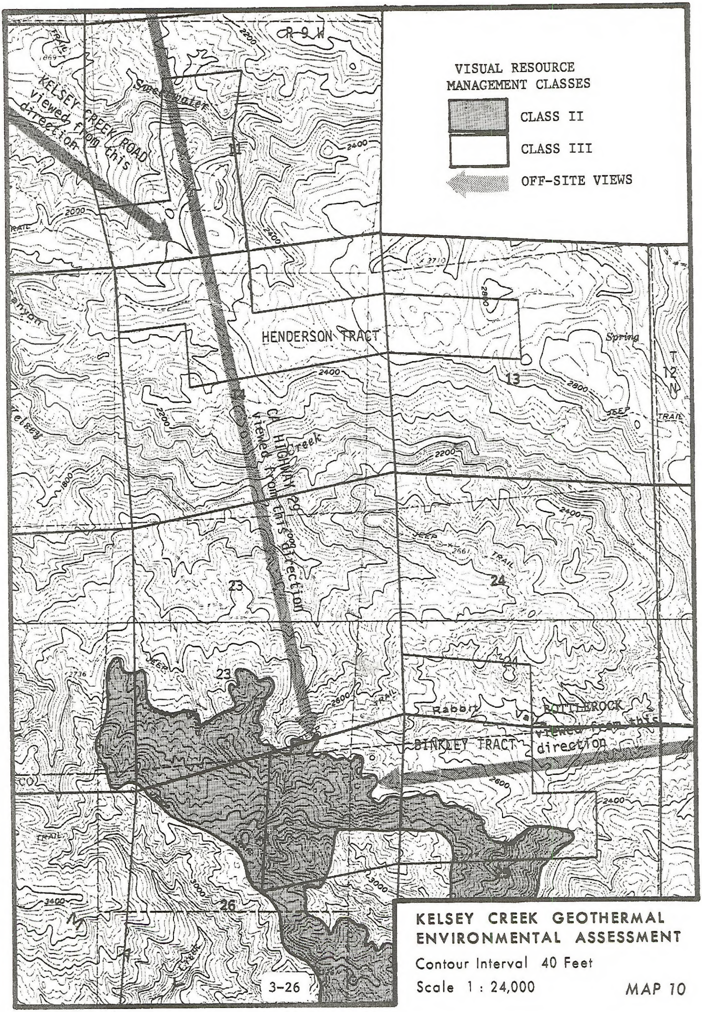
Class II - changes in any of the basic elements (form, line, color, and texture) created by a management activity should not be evident in the characteristic landscape. Contrasts are seen but must not attract attention.

Class III - changes in any of the basic elements (form, line, color, and texture) caused by a management activity may be evident in the characteristic landscape. However, contrasts should remain subordinate to the existing landscape and should borrow from the basic elements characteristic to the surrounding landscape.

Although the management classes allow for varying degrees of modification, the primary character of the landscape should be retained.

LAND USES

The land is not used by livestock and is, for the most part, not useable by livestock. There are 29 acres of grassland. However, the small size and the location of the grass as islands within a dense impenetrable chaparral stand limit accessibility and useability by livestock. The same problems exist for the narrow band of riparian vegetation found along the stream courses. Although the riparian type is composed of many palatable vegetative species, most of it is inaccessible because of the adjacent steep chaparral slopes and the occasional windfalled trees and large rocks that are located in and along the stream course.



KELSEY CREEK GEOTHERMAL ENVIRONMENTAL ASSESSMENT

Contour Interval 40 Feet

Scale 1 : 24,000

MAP 10

Since the land surface is privately owned, recreation use is limited to the surface owners and their guests. Recreation activities include fishing, hunting, riding, hiking, and camping.

Although the Study Area is located within a zone where commercial cinnebar mining (mercury) has been common, there were no obvious signs of past mineral prospecting or development on the Study Area. It is possible that the split ownership (private surface-Federal mineral) has been a deterent for mineral prospecting.

Presently, the highest potential value is for geothermal energy. Prior to the award of the geothermal resources to the United States on lands patented under the Stockraising Homestead Act, the surface owners leased the Study Area to geothermal developers. No geothermal development occurred under the private leases, due in part to the questionable ownership of the geothermal resources.

There is one unoccupied home within the Study Area, 7 other homes within 1½ miles, 5 homes east, and 2 homes west of the Study Area along the Kelsey Creek County Road. There are numerous homes within 2 to 4 miles of the Study Area. These homes are located along the Bottle Rock Road and at the southern end of the Kelseyville Valley. The community of Kelseyville is 5 miles north of the Study Area and Glenbrook is 3 miles southeast.

The Study Area has little potential for residential development because of the long and difficult access, the topography, the nearby steam field, and the underlying reserved Federal mineral estate.

There are some small mixed evergreen forests on steep north slopes and near the bottom of deep drainages. Because of the small timber volume, marginal soils, the scattered and difficult locations, and the poor transportation network, the timber has little, if any, commercial value.

The land has value as an investment opportunity, as would land elsewhere. The proximity of the steam field and the mineral reservation to the United States may adversely affect the investment quality of the land.

There are areas within the two tracts that are undisturbed, very scenic, and primitive, but because the Area is privately owned and is roaded, there is no possibility for a wilderness designation.

TRANSPORTATION NETWORK

There are no public access roads through the Study Area. Access to both tracts is by private roads that connect with the Bottle Rock County Road. The connecting private roads are narrow and crooked. Some are unsurfaced and provide seasonal access only. The Study Area has one improved (but seasonal) road and several access trails. Many of the trails are on ridgetops and used mainly for hunting access.

SOCIOECONOMICS

Population and Residential Use

The Study Area is located approximately 10 miles southwest of Clear Lake in an area that is sparsely populated with a relatively limited social and economic base. Communities in the vicinity of the Study Area include Kelseyville, Loch Lomond, Hobergs, Pine Grove, and Cobb. At present the economy of Lake County is principally oriented towards recreation and agriculture. Clear Lake is the main geographical feature and the principal tourist attraction in the County. Agricultural land use is mostly orchards and grazing. In addition, several hundred acres of vineyard have recently been planted.

Until recently, the main focus of geothermal development in The Geysers KGRA occurred in Sonoma County. Relatively little development activity occurred in Lake County. However, Lake County is now beginning to experience an increase in geothermal exploration and development activity.

Lake County is a rural county with a 1979 population estimated at 33,000 (Department of Finance 1979) and has experienced an average annual increase of 5.3 percent since 1970. However, very few people live within the immediate vicinity of the Study Area.

Employment

Employment in The Geysers area is dominated by geothermal work with several hundred people employed. Most commute from Middletown in Lake County, or from Cloverdale, Geyserville, and Santa Rosa in Sonoma County. Most of the people are in the construction trades, which total 4,500 people in Lake and Sonoma counties out of a total work force of 100,000.

Due to the specialized nature of the work, many of the people working on the large well-drilling rigs have been drawn from the oil and gas producing regions of California, Texas, and Oklahoma. However, as employment in the steam field grows, a resident well-drilling work force is developing.

On the Lake County side of the known geothermal resource area, the communities of Middletown, Cobb, Anderson Springs, Loch Lomond, and Whispering Pines are primarily recreation and service oriented. These communities have been less impacted by geothermal employment than those on the Sonoma County side of the field. However, as the Lake County area of The Geysers KGRA is developed, these communities will be impacted to a greater extent.

Taxes

Geothermal development has had a substantial effect on the property tax revenues in Lake and Sonoma counties. The relative impact is greatest in Lake County because it has a much smaller property base than Sonoma County. Thus far, almost all of the field development has taken place in Sonoma County.

Some of the most significant tax effects concern local school districts. PG&E has suggested that its Unit 13 in Lake County could noticeably reduce the overall tax rate in the Middletown School District. Lake County school tax rates have approximately tripled since 1970 due to inflation and a rapidly increasing enrollment. Enrollments in the nearby Sonoma County districts have declined in the same period.

Infrastructure

Infrastructure in the vicinity of the Study Area is limited to roads and power transmission lines. The existing roads are mostly private with limited access. The only nearby public roads are the Bottle Rock and Kelsey Creek Drive county roads.

The recent incursion of geothermal development into southwestern Lake County may significantly affect the population in this area. Each new development will increase the demand for labor, which raises concerns about the ability of this sparsely populated region to adequately absorb new residents without adversely affecting such things as the quality of public service and the supply of housing. Already, housing is scarce in the Lake County communities. New homes are being built on properties in the Area, but rental housing is extremely difficult for newcomers to locate.

Public Attitudes and Expectations

A 1975 survey of Lake County voters indicated a majority are willing to accept geothermal development "provided that it is suitably regulated to minimize negative environmental impacts." It is found that the expectation of economic benefits was a dominant factor in determining whether people favor development. People living adjacent to The Geysers, in places such as Cobb and Anderson Springs, were found to be less receptive to development. It is not expected that these attitudes have changed greatly since the survey.

The surface owners of the land acquired under the provisions of the 1916 Stock-raising Homestead Act feel a sense of disappointment stemming from the December 1977 Supreme Court decision not to review a lower court's decision to reserve the geothermal resources to the United States. Likewise, there is a sense of disappointment and frustration on the part of the geothermal developers who held the invalid privately issued leases to these lands.

The residents of the homes in the Area are somewhat resigned to a decreased quality of life resulting from nearby geothermal development. They continue efforts through the State and county agencies to cause the developers to take all possible measures to reduce environmental impacts.

Other Economic Land Uses

The existing land uses cannot economically compete with geothermal development. Currently, the most valuable uses are probably the residential-recreational use and hunting rights.

CULTURAL AND SOCIOCULTURAL RESOURCES

Cultural resources are defined as those fragile and nonrenewable evidences of human activity, occupation, and endeavor and natural features that are of importance in human events.

Sociocultural resources include places, objects, structures, and things of importance to a subgroup of the population at large. Included are values that reflect the concepts, religion, social heritage, habits, skills, and arts and lifestyles of a given people.

In compliance with Federal legislation, the Ukiah District Office contracted with the Sonoma State University Academic Foundation, Incorporated, on behalf of the Anthropological Studies Center, Sonoma State University, to complete a cultural resource evaluation of the Study Area. The investigations were designed to identify prehistoric and historic properties located within the Study Area. The Bureau also provided Sonoma State University with funds to complete an inventory of sites significant to Native Americans.

Archaeological Field Investigations

The archaeological investigations consisted of a Class III intensive field inventory. A Class III inventory is defined as a high intensity, on-the-ground cultural resource assessment in sufficient detail to identify and evaluate all cultural resources within a specified area.

As directed by the National Historic Preservation Act of 1966 and Executive Order 11593, the Ukiah District Office has contacted the State Historic Preservation Officer of California to determine the presence of existing *National Register* sites within the Study Area. In addition, the *Federal Register* listing of the *National Register of Historic Places* of February 1979 and monthly supplements through January 1980 were reviewed with negative results.

Cultural resource investigations for the general vicinity of The Geysers began in association with geothermal resources development during 1973 as part of Federal and county environmental impact statement requirements. Prior to that time, virtually no such work had been carried out.

Using data from The Geysers vicinity as a whole, including the present mineral reserve parcels, Fredrickson (1977) suggested that the distribution of what appeared to be late period prehistoric sites reflected the known ethnographic patterns of local tribelets and that earlier sites reflect a contrasting distribution. Fredrickson (1977) reported that the largest number of prehistoric sites were clustered within a 2-mile radius of The Geysers property, with site frequency then dropping abruptly off to less than one for every 2,000 acres. The contractor's reports contain a synopsis of regional prehistory, ethnographic background of the region, a history of the Study Area, and an ethnohistorical overview. The complete reports are available for review at the Ukiah District Office.

A total of 12 archaeological sites have been recorded within the Study Area. The Ukiah District Office will submit complete documentation to the State

Historic Preservation Officer and the Keeper of the *National Register of Historic Places* requesting determinations of eligibility for all cultural resource sites that were found. (Appendix B provides site descriptions.)

Native American Sites Inventory

The general objectives of the Native American sites inventory were twofold: first, to identify and evaluate, in consultation with local Native Americans, those prehistoric, historic (ethnographic), and contemporary cultural resources contained within the Study Area; and second, to make, in consultation with local Native Americans, recommendations for the management of those identified cultural resources having sociocultural significance within the Study Area.

The research strategy adopted to comply with the study requirements for conducting the Native American sites inventory consisted of three phases: prefield research, preliminary field work, and field work.

The prefield research phase included a comprehensive review of the published ethnographic, archaeological, and ethnohistoric literature related to the Study Area.

Field work with Native American consultants involved a review of the purpose and scope of the project and a description of the areas to be investigated. This also involved a field inspection by the field researchers.

Although all of these lands fall within the aboriginal territory of the Pomo, the scope of the study called for the documentation of any and all Native American usage of the lands in question, requiring contacts with all the Native American groups in the vicinity of the Study Area who might have used the area.

Eighteen knowledgeable Native Americans representing numerous organizations were consulted for the purpose of obtaining information about specific site locations. Interviews were directed to elicit data concerning the prehistoric, historic, and contemporary uses of the areas and to identify ethnographic and other culturally sensitive areas.

No sites of sociocultural significance to Native Americans were identified within the Study Area as a result of the Native American sites inventory.

HYDROLOGY, WATER QUALITY, AND WATER USES

The Study Area lands lie entirely within the Kelsey Creek Watershed. These lands drain directly into the mainstem of Kelsey Creek and into Sweetwater, High Valley, and Rabbit Valley creeks, which are tributaries of Kelsey Creek. Kelsey Creek is tributary to Clear Lake, Cache Creek, and the Sacramento River. The lands are 12 channel-miles south of Clear Lake, 8 miles south of the town of Kelseyville, and 4 miles south of the Kelseyville-Big Valley irrigation area.

A USGS stream gage (Number 11449500, Kelsey Creek near Kelseyville) is about 4 miles below the Study Area lands. Thirty-two years of records are available from this 36.6 square mile watershed. Average discharge is 75.5 cubic feet per second (cfs) or 52,530 acre feet annually. Extreme maximum discharge was 8,800 cfs, which occurred on December 21, 1955. Inspection of the channels of Kelsey and High Valley creeks verifies the past occurrence of large flood flows, channel scouring, and the delivery of a considerable amount of sediment to Clear Lake.

The purpose of the Kelsey Creek gaging station installation is to measure surface water supplies for the proposed Kelsey Creek Dam, which would augment the present irrigation of 13,170 acres of pears, walnuts, grapes, and field crops that presently utilize 25,720 acre-feet of water in Zone 5 of the Lake County Flood Control and Water Conservation District. Most of the present irrigation is through large diameter wells in shallow alluvium adjacent to the Kelsey Creek Channel. The town of Kelseyville and nearby populated areas draw 760 acre-feet per year of domestic water from this same source. The yield and quality of water from Study Area lands have a direct influence on these important downstream water uses; it could directly pollute the water that helps provide the livelihood for a population of 3,000 persons in the Kelseyville-Big Valley area. Water quality data for Kelsey Creek is not available. Big Valley (Lower Kelsey Creek Watershed) ground-water supplies have been reported as: dissolved solids, 381 to 760 parts per million; specific conductance, 535 to 963 micro-ohms per centimeter; chlorides, 7 to 15 ppm; sodium, 10 ppm; boron 0.8 to 3.3 ppm; pH 7.8 to 8.5; iron 0.02 ppm; nitrate 0.10 to 0.60 ppm; and sulfate 5 to 6 ppm. The continued good quality of water in Clear Lake is important to the economy of Lake County, as it helps to sustain high recreation values. As a major tributary of Clear Lake, Kelsey Creek has a direct effect on the Lake's water quality, nutrient supply, dissolved oxygen levels, and algae populations.

The Kelsey Creek water supply is fully appropriated under State water rights laws. There are recurrent water shortages in the Big Valley Basin. Therefore, use of Kelsey Creek water for geothermal development on mineral reserve lands may involve the purchase or lease of water from valid water rights permit-holders elsewhere in the Kelsey Creek Valley.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

PROPOSED ACTION

The following section describes the impacts that could result from implementation of the proposed action. The impact assessment documented below provides the basis for development of Lease Stipulations and Operational Procedures.

Climate, Air Quality, and Noise

Climate (Meteorological Characteristics)

Several microclimate variables can be affected by persistent emission of heated water vapor. Addition of this vapor to the atmosphere slightly increases ambient temperature and humidity and reduces insolation (incoming solar radiation). Due to the relatively low volume of emissions in relation to the absorption capacity of the overlying air mass, it is not anticipated that emissions from the proposed project would have a significant effect on local humidity and temperature.

During calm winter nights when drainage or downslope wind flows predominate, emission of water vapor may slightly increase the frequency and duration of fog within one-half to one mile of power plants.

Water vapor plumes from a cooling tower generally disperse rapidly. Beyond a radius of about one-third mile from a particular cooling tower structure, the combined contribution from all operating cooling towers must be considered in evaluating their effects on the environment.

In the absence of an intense inversion, the cumulative contribution of water vapor to the atmosphere from all power plants presently operating in The Geysers KGRA would result in only minor changes to the area's climate.

For the annual average wind speed of 11 miles per hour, the contribution at downwind distances of 5 to 10 miles from 11 operating units is less than 0.1 gram of water vapor per cubic meter of air. At the coldest temperatures expected in the area, saturated air would contain at least three grams of water vapor per cubic meter. This addition of water vapor corresponds to a change of less than $1^{\circ}F$ in wet-bulb temperature readings.

During the dry season of April through October, the capacity of the air for water vapor ranges from 6 to 40 grams per cubic meter. The addition of cooling tower water vapor from all units during this period would not change the wet-bulb temperature more than $0.5^{\circ}F$. During this dry season, the area is generally in or above the inversion so that the relative humidity is low and the addition of cooling tower water vapor causes an insignificant change (CEC 1979).

Air Quality

As indicated in Chapter 3, the air quality of the Study Area is affected by the hydrogen sulfide produced at The Geysers field. Power plants and standby wells are the main sources of hydrogen sulfide. The power plants are being retrofitted with hydrogen sulfide abatement equipment. The retrofit schedule shown on Table 9.

Research is continuing for more effective and efficient methods of hydrogen sulfide abatement. Pacific Gas and Electric Company recently field tested a model system that removed hydrogen sulfide before the steam enters the turbine. Plant 13, which came on-line in April 1980, is equipped with the Stretford system and, in addition, will have a computerized system to shut off the wells when the steam is not needed at the power plant.

Among the latest developments, and in order to receive certification for SMUDGEO #1, Sacramento Municipal Utility District has agreed to:

1. Install the standard Stretford system.
2. Install a secondary condensate treatment system using hydrogen peroxide.
3. Use a turbine bypass mechanism.
4. Install various minor improvements, such as extra gland seals, lower condenser back pressure, etc.

This equipment is expected to allow SMUD to meet the more stringent standards which will take effect January 1, 1985.

Information from wells drilled for Units 11 & 17 suggests that the concentrations of pollutants in this section of the KGRA would be greater than the concentration experienced in most other developed areas of the KGRA. These facts imply a greater need for a highly efficient H2S abatement system to meet air quality standards and avoid adverse environmental impacts.

It is anticipated that as a result of leasing this Study Area, the equivalent of 22 steam wells and one 110-MW power plant could be built. The two study blocks are physically separated by more than one mile so that either the steam will go to separate units or, possibly, two smaller (55-MW) plants could be built.

Noise

Development of the Kelsey Creek Study Area would increase the noise levels. There are 11 homes located near the Study Area. Impacts would be minimal, except for those individuals directly involved with geothermal activities, such as for construction crews. Table 10 illustrates noise levels due to activities at a plant site (NCPA), and Table 11 shows sound levels due to specific geothermal development activities (Tucker & Tanner 1978).

TABLE 9

Power Plant Hydrogen Sulfide Abatement Schedule

Power Plant	Megawatts	Retrofit Date
* 1	11	7/84
* 2	13	7/84
* 3	27	12/1/76
* 4	27	9/30/76
* 5	53	10/1/77
* 6	53	10/1/77
* 7	53	6/83
* 8	53	11/85 or 2/86
* 9	53	7/84 or 11/84
*10	53	7/84 or 11/84
*11	106	5/31/75
*12	106	7/1/78#
*13	135	4/1/80#
*14	110	6/1/80#
*15	55	5/80**
	908 mw (Sub total)	
16	110	1/1/83#
17	110	7/1/82#
18	110	10/1/82#
19	110	1982#
20	110	1983#
21	110	1983#

(con't)

Power Plants	Megawatts	Retrofit Date
NCPA:		
NCPA 1	66	1983#
NCPA 2	110	1983#
Dept. of Water Resources:		
Bottle Rock	55	1983#
So. Geysers	55	1983#
SMUD:		
SMUD Geo. #1	55	1983#
	1909 MW Total	

2 Units on one side

* Operational

** Surface condenser/stretford alone was not effective. Retrofit with Peroxide/HAA catalyst.

# Will have abatement equipment installed @ startup

TABLE 10

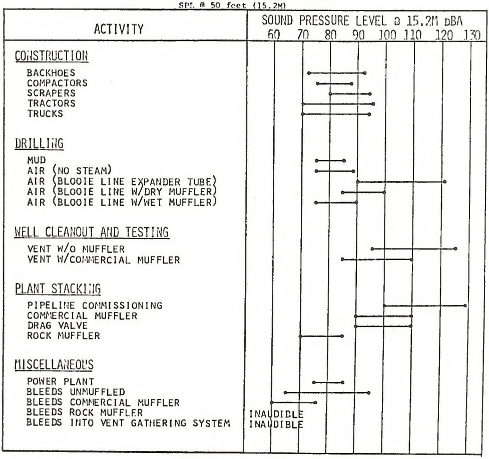
Predicted noise levels due to activities at the NCPA/Shell power plant site.

Noise Source	Maximum Sound Level at 50 feet (dBA)	Sources of Noise Attenuation			Predicted Level at Camp Verdant Vales
		Wave Divergence (42 dBA)	Excess Attenuation (10 dBA)	Barrier (10 dBA)	
Site Construction	95	53	43	33	33 dBA
Clearing Steam Pipelines	120	78	68	58	58 dBA
Normal Power Plant Operation	85	43	33	23	23 dBA
Outage Condition (Steam Venting)	100	58	48	38	38 dBA

Source: NCPA 2 - Notice of Intent Volume 2.

TABLE 11

SOUND LEVELS ASSOCIATED WITH
GEOTHERMAL DEVELOPMENT ACTIVITIES
SPL @ 50 feet (15.2M)



Source: Geothermal Environmental Seminar 1978
Tucker, Fayne L. and Lane R. Tanner, eds.
Sacramento, CA.

Geologic Hazards

Seismic Activity

The question of increased seismic activity arises from the action of withdrawing fluid from or reinjecting fluid into the geothermal reservoir. Injection of fluids into deep wells has been recognized as the cause of earthquakes near Denver and Rangely, Colorado. In those cases, water was injected under very high pump pressures into very deep aquifers. Because the method of injection at The Geysers is under hydrostatic head, as opposed to high pump pressure, the potential for inducing earthquakes by reinjection appears to be small.

Landsliding

Geothermal development activities could contribute to the formation of new landslides and renewed activity in existing landslide masses. The extent of possible new activity would depend on the characteristics of each landslide and on the type of geothermal activity occurring on each landslide. The potential for activation of new or renewed landslide activity within the Kelsey Creek area, with standard engineering design and construction measures applied, is slight to moderate. If landsliding occurs in an area where geothermal development is taking place, the secondary impacts would include impacts on the environment and on geothermal development. Since many of the landslides cross property boundaries, off-site impacts could occur.

Many of the identified inferred landslide masses (Map 5) appear to be dormant or static slumps and flows, which have reached a point where they are relatively stable. Anticipated adverse impacts from development on these landslide types would be fairly low if adequate precautions are observed.

Impacts of Landsliding on the Environment. There are many potential impacts from landsliding that could occur within and beyond the Study Area. Some of these impacts include: (1) increased soil and bedrock instability, (2) soil erosion, (3) increased stream sedimentation, (4) degradation of water quality (landslide-induced reserve-pit failures), (5) loss of vegetative cover, (6) impacts on wildlife and fish due to habitat loss and blockage of spawning streams, (7) degradation of air quality and excessive noise (landside-induced geothermal well-casing rupture), and (8) impacts on the visual environment.

The severity of impacts would depend on the area involved and where the slide debris would be deposited. For example, a large landslide transporting large quantities of debris a great distance and depositing the debris into a major stream would have major environmental impacts.

Impacts of Landsliding on Geothermal Development. The impacts of landsliding on geothermal development could include damage to access roads, well pads, reserve pits, steam and electric transmission lines, and power plant facilities. The degree of these impacts could range from occasional minor disturbance, requiring repair of affected facilities, to extensive instability, causing steam well blowouts and severe damage to power plants. The occurrence would largely depend on the intensity of development and how sensitive the site selection procedures are for the various facilities associated with geothermal development.

Soils

General Impacts

Major impacts on the soil resource would occur from such activities as road, pad, and steam production-line construction. These impacts are due to: (1) loss of soil productivity because of excavation and burial of the more productive surface soils; (2) soil compaction, which in turn increases erosion and sedimentation due to permeability; and (3) removal of vegetation. Excavation for construction exposes poorer quality soils on steep slopes that do not have the productive capacity to grow vegetation that they previously had. Less vegetative cover results in accelerated erosion, causing downstream damage. The greatest overall impact from leasing the two tracts may be off-site. Access road construction to the two areas could cause major impacts.

Specific Impacts

Geothermal activity on the serpentine soils (Montara and Henneke) would permanently leave the soil surface bare to accelerated erosion. Revegetation efforts have seldom been effective on serpentine soils.

Major impacts of sheet and stream-bank erosion with resulting sedimentation would occur if the steep side slopes of Sweetwater and High Valley creeks are disturbed by road construction.

Impacts on the soil would be greater on south-facing slopes than north-facing slopes because of higher soil temperatures, shallower, drier soils, and less dense vegetation. Revegetation of disturbed sites reflects these limitations. Revegetation efforts to get cover on disturbed construction sites on south-facing slopes is not as successful as on north slopes.

Maymen, Etsel and Neuns gravelly loams on slopes over 35 percent are difficult to revegetate with grass species. Native vegetation is chiefly shrubs, such as manzanita, chamise, and ceanothus, which are generally hard to re-establish by seeding or planting. Seeding with grass species is also generally hard to establish and would not provide enough cover to protect the surface from rainfall. Fine to coarse soil particles would erode from the soil surface until such time as gravel fragments adequately protect the surface. Dry ravel (movement of small rocks down slope) would once again subject fine materials on steep slopes to erosion. Long-term sheet and splash erosion would be expected on these soils.

Hydrology and Water Quality

The impacts that geothermal development would have on water quality depend on many varying conditions, including surface slope, vegetative type, present ground cover, soil type, distance from streams, and the type and extent of surface disturbance.

Water quality degradation could occur due to soil erosion as a result of surface disturbance from road and pad construction, pipelines, earth fills, and landslides. Accelerated erosion and water runoff increase the velocity of flow in water courses resulting in streambank degradation, channel cutting, and increased sedimentation.

Toxic materials could enter water courses through mishaps (sump failures, pipe breaks, well blowouts, etc.) or through vented steam when occurring near a stream course.

A major impact of geothermal development on water quality would be the seasonal flush of sediment and nutrients into the ephemeral draws and the main channel of Kelsey Creek for transport to Clear Lake. The sediment is either deposited in a delta or is carried out and deposited in the bottom of this relatively shallow lake. Associated with this sediment transport is a flush of nutrients which will contribute to the noxious growth of bluegreen algae populations, algae growth, and an intense eutrophication problem which exists in the Lake.

Vegetation

General Impacts

The significance of vegetation disturbance is directly proportional to the amount of area and intensity of surface disturbance. Area of perpetual use, such as roads, pads, and steep earthern cut-fills, would likely remain barren due to loss of top soil or soil compaction. Areas of limited use or minimal disturbance, such as prescribed burns, exploratory drill sites, etc., may revegetate to the original composition and density within 10 years depending on vegetation type. Vegetation can also be detrimentally affected by chemical contaminants in the steam from power plants and well sites if the foliage is in direct and continuous contact with them.

A secondary impact that is difficult to quantify concerns the introduction of exotic plant species. These plants generally flourish in disturbed areas, which may represent up to 15 percent of the surface area in a fully developed geothermal field. These plants may compete with native plants, thus slowing the natural succession of the vegetative community or allowing for the establishment of a disclimax vegetative community.

Rare, Threatened, and Endangered Plants

There are no known beneficial impacts to rare, threatened, and endangered (RTE) plants from geothermal development. The negative impacts that are associated with geothermal development are:

1. Surface disturbance activities may partially or completely destroy the plants and/or their potential habitats.

2. Geothermal steam originating from power plants and well sites, as previously mentioned, can kill plants. As previously discussed, there is little possibility that the steam being released would modify the microclimatic environment, thus affecting the plants.

3. Offsite construction surface disturbance can also affect adjacent habitats of RTE plants through dust deposits and diversion of springs and subsurface water. The latter effect could reduce (or increase) water availability to plants and could accelerate erosion.

4. Increased access to the Study Area would increase the chance of introducing new plants into the habitat, thus leading to direct competition with RTE plants and their habitat. The habitats of some sensitive species are generally barren and attractive to off-road vehicle riders.

Wildlife

Terrestrial

General. While analysis is not complete, preliminary data developed under present criteria indicate that wildlife response to what is termed developed or undeveloped steam fields is mixed. In some cases there appears to be no significant difference (Pacific Gas & Electric 1977).

The various phases of geothermal field development would affect wildlife species to varying degrees, both short-term and long-term. Many species may be frightened away from local development. Those animals adapted to disturbance would remain and possibly increase in number. After development is completed and human activity declines, it is anticipated that most wildlife would return to the area. Where human activity remains or where vegetative disturbance has been greatest, use by some species would be precluded or impaired.

Specific Impacts (Including Rare, Threatened, and Endangered Species). Geothermal development on the Study Area would likely result in minor impacts to the golden eagle and peregrine falcon. Although some loss of foraging activity would be likely, the U.S. Fish and Wildlife Service has concluded that geothermal development would not jeopardize the continued existence of the peregrine falcon.

The ring-tailed cat could be adversely impacted, depending on the magnitude of development and human disturbance. Other mammalian predators, particularly the mountain lion, would also be affected. The Cooper's hawk and pileated woodpecker are especially sensitive to disturbance.

Revegetation of cut and fill slopes would provide foraging areas for deer and raptors adapted to open areas, such as the redtailed hawk (*Buteo jamaicensis)* and the kestrel *(Falco sparverius)*.

Many wildlife species are dependent upon or prefer riparian and streamside areas because of the wide variety of habitat requirements they provide (Pacific Gas & Electric 1977). Depending upon the kind and amount of development in and adjacent to the riparian zones, such as removal of vegetation, changes in water flow and quality, physical alterations of existing configuration, and increased human disturbance, various impacts would occur to associated wildlife species.

The least mobile species, including amphibians and fishes, would be most affected by intensive development in water areas. Removal of vegetation in these areas would reduce nesting and foraging habitat for a wide variety of birds. Development and activity in and adjacent to these important wildlife concentration areas would preclude their use, particularly by the larger and warier species (such as mountain lion and bear) and limit their use by other species to varying degrees.

Data developed in the Comarc Design Study (1975) indicate that streamside vegetation types are the most sensitive to disturbance and are very important to wildlife.

Geothermal steam development would reduce the amount and/or quality of game species habitat to varying degrees. With the exception of black bear, most game species present are adaptable to habitat disturbance, and impacts to those populations would be low. While the habitat modifications to the proposed lease area may appear minor, they must be considered along with the effect of existing and future geothermal projects.

Aquatic Wildlife

Impacts on aquatic life would be lessened by measures that reduce stream sedimentation and maintain stream shade to keep temperatures in the lower ranges required by native trout. The measures identified in the soils, hydrology, and vegetation sections would provide that protection.

Palenotological Resources

Geothermal activity, as envisioned for the Area, would have little, if any, effect on any significant paleontological resources. None of the fossils encountered to date would come under the purview of the Antiquities Act.

Cultural and Sociocultural Resources

Impacts on archaeological and historic sites would consist of changes from their original condition. Since the information content of these sites resides largely in their physical structure, any structural change constitutes a stage in the erosion of the total information base. Moreover, such changes are permanent and irreversible. In this light, all changes must be considered adverse impacts, as no change in physical structure benefits or "improves" cultural sites; although some programs of research, including excavation, may make their information content more accessible. The only beneficial impacts relating to cultural resources are those that reduce the intensity of factors promoting change.

Direct impacts on cultural resources may occur as a result of any surface disturbing activity, including geophysical exploration, geochemical surveys, improvement of old roads, new road construction, culvert implacement, transmission lines, pipelines, well-drilling pads, and power plant construction. The impacts caused by such ground disturbance could result in a change in orientation of site components or possibly the complete destruction of those resources. The degree of impact correlates directly with the amount of new surface disturbance and the size of the site, cultural consituents, and/or site density.

By nature, some types of sites are more sensitive to damage by geothermal activities than others. Due to their location, petroglyph sites, for example, would be less likely to be directly disturbed by most types of geothermal activity but could be impacted by destruction or alteration of their environmental settings. Intra-site proximity patterns and material distribution arrangements are extremely fragile and must be studied in great detail to obtain potential scientific and interpretive values. Once cultural materials are disturbed or removed from their original context, their potential scientific value is greatly decreased.

The full range of potential impacts is difficult to assess. According to Neilson, et al., (February 1975, p. 66), "it is obvious that geothermal development at The Geysers constitutes a very real threat to surface features, including archaeological sites existing within the area. For each generator site, an area of 800 to 1,000 acres is involved. Twenty to over 50 percent of the surface may sustain major changes . . . . The high relief of the region necessitates massive cutting, filling, and grading in order to establish flat work surfaces." Recent techniques, particularly that of using one pad for several wells, have reduced Neilson's estimate of surface change to 7 to 15 percent.

The area of potential impact would include development sites such as steam wells, pipelines, support roads, power transmission lines, as well as the generator itself and associated cooling towers. Administrative office, service centers, switching stations, and sulphur waste disposal facilities also add to the land use burden.

Visual Resources

Geothermal development in the Kelsey Creek Study Area could adversely impact the existing natural landscape character if striking contrasts occur in the form, line, color, and texture of the present landscape features. The landscape surrounding the Study Area has just recently begun to show the effects of geothermal expansion from the Geysers Basin. Impacts would be most visible as a result of the removal of vegetation and soil disturbance associated with the construction and operation of roads, well pads, steam pipelines, generating plants, and electrical transmission lines.

In order to assess the visual impacts of management activities, the BLM employs a contrast rating system to measure the degree of contrast between a proposed activity and the existing landscape. In order to meet the Visual Resource Management (VRM) objectives, the degree of contrast must be within the specified allowable amount for the management class of the area. See Appendix C for examples of contrast ratings for five geothermal activities.

The Kelsey Creek Study Area includes both Class II and Class III management lands. The objective for both classes is to limit the amount of contrast for any of the basic elements to a moderate value or less. The Class III lands, however, permit a greater cumulative effect of contrast for any of the landscape features; landform/water, vegetation, and structures.

In the early exploratory stages of geothermal development, new roads and trails would introduce new lines and alter the color and texture of the landscape as a result of vegetation removal and soil disturbance. As roads are cut over ridgelines and across steep slopes, as is typical in the study areas, they become more visible and the impacts greater.

Well pads introduce form changes as a result of site clearing and excavation. Vegetation removal results in color and texture contrasts by interrupting natural patterns. Drilling platforms and towers, although temporary, attract attention through the introduction of man-made vertical structures uncharacteristic of the natural landscape. Often these structures occur on ridgetops, giving a silhouette appearance against the skyline.

The field development and production stages are the focus of major long-term visual impacts. Surface disturbance and vegetation removal continue, resulting in contrasts with a greater magnitude than before.

The grading, construction, and maintenance of steam pipelines have the same general impacts as road developments. The potentially extensive network of pipelines and further disruption of natural landscape patterns result from the consistent and repetitive tubelike forms and unnatural color and texture of the pipes.

The surface disturbance required for a generating plant would alter the form, line, color, and texture of the characteristic landscape. A generating plant itself, with cooling towers, associated buildings, and maze of pipelines and valves, concentrates visual impacts with its massive scale and introduction of rectilinear and cylindical industrial forms. These impacts are accentuated when a power plant is located on a ridgetop, causing the structures and steam plumes to be silhouetted against the skyline.

Transmission lines would introduce new form, line, color, and texture not only to the project site but throughout the regional landscape. The transmission towers introduce man-made vertical forms to an otherwise undulating landscape.

The impact of the towers and lines can vary greatly depending on siting -- whether or not the transmission lines follow ridgetops along the skyline, or if located lower on the slopes so that landforms act as a visual backdrop.

Steam plumes result from venting wells and from the cooling towers of generating plants. They can be visible from great distances due to their contrasts against the landscape and sky. The soft-edged effect of the plumes is transitory yet very dynamic in nature, affecting all the basic elements due to the changing patterns against the landscape.

The Air Quality Act references visibility in conjunction with air quality. As geothermal development continues to expand, the particulate matter in the air increases. As a result of the cumulative effects to air quality, visibility can be substantially reduced. The Clear Lake area is known for its distant and pristine views. In order to protect this characteristic, emissions would have to be held to a level that would not diminish visibility.

The following chart summarizes the effects of various geothermal activities. It is generalized and intended to give indications of the relative magnitude of contrasts and resulting impacts of geothermal activities.

	Form Contrast	Line Contrast	Color Contrast	Texture Contrast	Overall
1. Roads	0	●	●	0	X-●
2. Drill Pads	●	0	●	X	X-●
3. Disposal Ponds (Sumps)	●	0	X	0	0
4. Steam Pipelines	X	●	●	0	X-●
5. Power Plant	●	X	X	X	●
6. Powerlines & Towers	●	●	X	0	X-●
7. Steam Plumes	X	X	X	X	X

● Strong Contrast
X Moderate Contrast
0 Weak Contrast

Specific impacts depend on specific site conditions such as topography and vegetative cover, as well as siting and design. The impacts are greatly affected by distance and angle of observation from which a project will be viewed, length of viewing time, relative size and scale of the project, seasonal and atmospheric changes, and alterations over time.

Land Uses

Geothermal development alters the natural landscape, thus affecting recreation use that is dependent to varying degrees on such naturalness. An increased number of roads, industrial structures, additional noise and traffic, and less wildlife would all adversely affect recreation qualities.

At the present time, there is no livestock grazing on adjacent lands. However, there may be potential for future grazing use. Intensive livestock management would be necessary to adjust to geothermal development impacts. Additional roads would change the typical grazing patterns of the area. Although drifting away from their range is a problem, livestock use of roads would also make them more vulnerable to harassment and injury loss.

Geothermal development would result in additional hydrogen sulfide odor, noise, traffic, and visual pollution. The value of existing residences would be affected, particularly the second homes or recreational homes whose values are closely associated with a natural environmental setting. Also, homes in the more remote areas are presently accessible by private roads. This restricted access is their only protection from such acts as vandalism and theft. With development and with possible less restrictions on public access, the isolated, remote, and particularly unattended second home is very vulnerable to illegal acts.

Because of the new and improved roads that would result from geothermal development, the Study Area would become more accessible to mineral prospecting. If a valuable mineral is found, the road network would be of benefit to its development.

Timber values may improve as a result of improved vehicular access. However, with improved access the possibility of wildfires would be greater.

Transportation Network

The existing private roads leading to the Study Area are generally not suitable for the transportation of heavy, massive drilling equipment. These roads require realignment, grade modification, stronger bridges, and surfacing all-weather use. Since the roads are private, the geothermal developers would have to acquire from the surface owner the rights to use and improve the roads. Also, additional roads within the Study Area would have to be constructed.

Unavoidable Adverse Impacts

Air Quality

Local air quality would be affected by exhaust from construction equipment and drilling rigs and by dust raised during construction operations. At full development, additional power generator facilities would contribute additional noncondensible gases to the atmosphere. It is anticipated that any new units yet to be constructed would install the required abatement equipment before the plant was placed in operation.

It is possible that no power plant would be constructed as a result of the proposed action (geothermal leasing). The State of California reviews and certifies power plant designs prior to construction. The State will not certify power plants that would not be in compliance with State air quality standards.

Soils

Soil productivity would be reduced or lost through burial under roads and pads or by the topsoil material being removed, exposing poor quality subsoils. This impact would vary considerably but, estimating between 7 and 15 percent surface disturbance by construction, this would amount to between 62 and 132 acres.

Hydrology

Mitigating measures applied to surface disturbance to lessen impacts are never totally successful, creating a cumulative sedimentation and water quality problem as more and more area is developed. Increases in sediment yield and stream turbidity occurring from surface distrubance would continue through the life of the geothermal field and for an estimated 20 years beyond. The total magnitude of this problem is unknown.

Vegetation

Temporary loss (10-25 years) or permanent loss of native vegetation would be the primary impacts on the vegetative communities, depending on the nature and intensity of the surface disturbance activity.

A secondary impact, which is difficult to quantify, concerns the introduction of exotic plant species. These plants generally flourish in disturbed areas and may compete with native plants, thus slowing up the natural succession of the vegetative community or allowing a disclimax vegetative community to establish.

Rare, Threatened, and Endangered Plants. If the breeding numbers of RTE plants were inadvertently reduced due to surface disturbance, the end result could be possible local extinction of a species.

Wildlife

Terrestrial Wildlife. Impacts to wildlife from geothermal development center around loss and degradation resulting from construction of roads and steam and electrical transmission lines, the dissection of habitat into unusable areas for some species, increased human activity and noises, increased siltation, spills of various toxic substances, and possible effects of cooling tower emissions.

Geothermal development would result in the loss of a yet to be determined amount of wildlife habitat. In areas disturbed but not completely destroyed, subclimax species appear to benefit at the expense of species adapted to climax conditions (Leitner 1978). Generally, impacts would be greatest in the nonchaparral vegetation types.

Overall, impacts within individual leases are low in magnitude. The sum of all these impacts throughout The Geysers KGRA results in a large area of habitat loss and disturbance. The assessment of total impacts to the entire geothermal development area is beyond the scope of this document. Table 12 summarizes anticipated impacts to terrestrial wildlife habitats resulting from leasing the Kelsey Creek Study Area for geothermal development.

Endangered and Protected Species. No significant potential impacts have been identified for the endangered and protected species in the Area. Minor disturbance could occur to habitat used for feeding by the peregrine falcon and golden eagle. Much of the preferred foraging habitat for the peregrine would be protected by geothermal development protection zones. Key habitat areas for the ring-tailed cat would also be protected by streamside buffer zones.

Aquatic Wildlife. Because protective measures are not completely effective in reducing sedimentation, some loss in aquatic productivity would be probable.

Cultural Resources

By promoting increased human activity in the Area, development could result in intensified vandalism and inadvertent destruction of cultural resources. Salvaged sites would suffer information loss due to the limitation of current archaeological techniques. Since archaeological data recovery techniques are constantly being refined, it is inevitable that any site excavation now could be better excavated in the future if it were preserved.

Certain indirect impacts to the resource base could be unavoidable. These impacts would be caused by construction-related erosion and increased access to workers, recreationists, unauthorized collectors, and off-road vehicles.

Visual Resources

Geothermal development, such as roads, well pads, steam pipelines, generating plants, and transmission lines, all present a certain degree of unmitigated visual impact. The degree of impact caused by imposing such industrial development on a rugged natural landscape lies in the site planning and design

TABLE 12

SUMMARY OF UNAVOIDABLE IMPACTS ON TERRESTRIAL WILDLIFE

Vegetation/Habitat Type	Comments	Anticipated Impacts	Overall Impact Magnitude
Riparian	Riparian habitats and streamside areas are protected and maintained by undisturbed buffer zones, and if access is not developed along Kelsey Creek, then the anticipated impacts apply.	Minor human disturbance including noise resulting from possible development adjacent to riparian protection zones. Warier animals, such as the larger carnivores and raptors, may sustain slight disturbance.	Low
Mixed Evergreen Forest	A significant amount of habitat loss and disturbance may occur in upprotected portions of this habitat. The majority of the better developed mixed evergreen habitat is included in streamside protection zones, so impacts on the whole would be minimal.	Low to moderate impacts would occur to deer, squirrel, quail, and dove. In disturbed areas, songbird densities may be reduced by 50% and number of species by 30%. Habitat for cavity dependent mammals and particularly birds would be lost. Feeding patterns of the carnivores and raptors, such as fox, bobcat, weasel, and Coopers Hawk, would be disturbed.	Low (with up to 50% of the unprotected area developed)

SUMMARY OF UNAVOIDABLE IMPACTS ON TERRESTRIAL WILDLIFE

(Continued)

Vegetation/Habitat Type	Comments	Anticipated Impacts	Overall Impact Magnitude
Grassland (Annual)	Wet meadow areas would be protected. Watershed and soil protection measures further reduce area of development.	A minor amount of deer fawning area may be lost and forage for deer would be reduced should buildings be constructed. Habitat could be reduced for several species of small rodents and granivorous birds. Raptors such as the red-tailed hawk and golden eagle that feed in open areas during daylight would experience slight disturbance and loss of habitat. The same applies to the larger predators, including the coyote, gray fox, and bobcat.	Low
Serpentine Chaparral	Significant disturbance primarily in the form of roads and trails already exists in the area.	Similar to chamise chaparral but in less magnitude. There would likely be some habitat loss and disturbance to raptors, including the red-tailed hawk and golden eagle that feed on small diurnal mammals such as the jackrabbit and ground squirrels in open areas.	Low

SUMMARY OF UNAVOIDABLE IMPACTS ON TERRESTRIAL WILDLIFE

(Continued)

Vegetation/Habitat Type	Comments	Anticipated Impacts	Overall Impact Magnitude
Mixed Chaparral	Greater impacts would be expected to occur in mixed chaparral than in other types of chaparral.	Loss and degradation of habitat and disturbance would result in low to moderate impacts to deer and quail. In disturbed areas songbird densities may be reduced up to 45% with a 20% increase in kinds of birds (species) present. Major small mammal prey species, such as the deer mouse, would likely increase in disturbed areas, while the pinyon mouse and woodrat would decrease. Movement and feeding patterns of the larger carnivores and raptors would be altered. Common reptiles, such as the Western fence lizard would be expected to increase in disturbed areas.	Low to Medium
Chamise Chaparral	Similar to mixed chaparral.	Similar impacts to mixed chaparral, but in less magnitude since overall wildlife values are lower in this drier, less diverse subdivision of chaparral.	Low

SUMMARY OF UNAVOIDABLE IMPACTS ON TERRESTRIAL WILDLIFE

(Continued)

Vegetation/Habitat Type	Comments	Anticipated Impacts	Overall Impact Magnitude
Knobcone Pine	Knobcone pine forests contain little plant diversity and provide limited habitat requirements for wildlife in themselves. In small groups and along their edge, they provide habitat cover.	Minor loss of cover and disturbance would occur primarily for quail, dove, several species of chaparral songbirds and, to a minor extent, deer.	Low

NOTE: Habitat values are greatest where two or more vegetation types (diversity of habitats) adjoin. Therefore, potential impacts to wildlife are increased in these areas. This is particularly true in areas of complex vegetation, such as found on portions of the Binkley parcel, and when the more valuable vegetation types, such as riparian, mixed evergreen, and oak woodland, are involved (Map 7).

of specific projects as well as the total development scenario. The basic loss of soil, vegetation, and resulting visual quality, regardless of relative value, will be permanent.

If Class II lands are not disturbed and mitigation procedures for Class III lands are adhered to, the resulting visual impact of the overall geothermal development should meet the visual resource management objectives for the Kelsey Creek Study Area. In certain areas the only indication of geothermal activities would be occasional steam plumes.

Land Uses

The transition from a wildland area to an industrial area would, for the most part, preclude the recreational activities now enjoyed by the surface owners.

Since the Study Area is not used by livestock, there would be no present impact on grazing. However, any future opportunity to establish a livestock operation by the surface owner would be affected. Livestock and geothermal development are not compatible. New roads greatly increase vehicular traffic and provide access to more people. Injury to livestock and rustling could occur in the geothermal field. Harassment of livestock can also be a problem that can result in weight loss, separation of calves from cows, and driving livestock from their customary grazing areas.

If a geothermal resource is found on the Study Area, development would occur there as well as on nearby Federal and non-Federal geothermal leases. Therefore, the impacts to the environment and to the residential owners from the proposed action would be an incremental increase to total field development. Although the Study Area has little value for residential use, geothermal development would further reduce the value. The existing home on the Study Area would not continue to provide the owner with the same quiet, undisturbed haven that it now provides. Increased traffic and noise would also affect the other homes around the area.

Short-Term Uses Versus Long-Term Productivity

For the purposes of this assessment, short-term means the time during which the steam wells, power plants, and transmission lines are in operation, even though this may be 30 or more years.

Committing an area to geothermal development from exploration through power generation is a total commitment of up to 15 percent of the affected area to that use. Within the 15 percent, incompatible uses would be precluded or reduced to some extent.

The Steam Resource

At present, it is unknown how long the geothermal resource will last or if it will be available for use by future generations. It is possible that a more productive use of the resource might be found. Additionally, improved technology might better eliminate or mitigate environmental impacts if development were delayed.

The Surface

If the buildings, steamlines, and powerlines are ever no longer required (as in closeout of operations), it is possible to remove them and, except in steep areas, to reshape the land surface to a reasonable approximation of the original contours. Since steep topography is avoided as much as possible to reduce both environmental and economic costs, most of the land could be rehabilitated. Native vegetation and fauna would move into the Area, either naturally or with man's assistance. Other surface uses, primarily recreation, which were reduced or eliminated by the action, would again be possible. In the long run, therefore, the action appears to have little permanent effect on the productivity of the land surface. Areas, such as rock cuts, that could not be rehabilitated would constitute a very small percent of the developed areas.

Areas occupied by more permanent developments would be lost to use by wildlife as long as the project(s) exist. Impacts beyond the life of the project(s) would depend on the degree to which the Area is rehabilitated. Undesirable effects resulting from the accumulation of toxic substances and changes in water regimes could endure beyond the life of the project(s).

The primary impact on cultural resources probably would occur during the short-term use of the Area for geothermal development. Some of these impacts could have long-term consequences, such as the loss of the prehistoric and historic cultural resource base.

Offsite Effects

To the extent that power is derived from steam, it does not need to be generated from some other source. These other sources now include fossil fuels, atomic power, or hydroelectricity. (Other power sources may be developed during the life of this project.) Each kind of power generation has its own peculiar environmental impacts and consequent effect on productivity. A commitment to steam development means that the impacts and consequent impacts associated with the alternate sources of power would not occur. It is also possible that conservation and waste reduction measures may eliminate the need for power from steam from the Federal mineral estate. The matter is too complex to determine what would happen if the subject lands were not leased for steam development. Therefore, it is not possible to say whether steam, oil, coal, gas, or land and water would be depleted with a specific effect on long-range productivity.

Irreversible and Irretrievable Commitment of Resources

The loss of soil through erosion from exposed surface areas represents an essentially irretrievable commitment of the resource. While soil formation is a continuing process, the time periods involved are so long that the loss can be considered essentially irreversible. The quantity of soil loss would depend upon the effectiveness of the measures discussed in Chapter 2.

If vegetative conversion results in replacement of native vegetation by introduced species and these species are able to maintain themselves in a persistent subclimax or climax community, the change would be irreversible.

The development of a full-field geothermal project would cause possible irreversible impacts on fish and wildlife habitat. Because fish and wildlife resources cannot be stockpiled, the annual production of fish and wildlife foregone during the life of the project must be considered as irretrievable - they cannot be replaced or restored.

The utilization of the steam resource constitutes an irreversible commitment. Once used, it is gone. Although in theory the field may recharge itself, the time required may be too long to consider in human terms. At this time the field recharge time is unknown.

On the other hand, if steam is not committed to power generation, some other source must be used in its place. Therefore, a decision to generate power is, in itself, a commitment of some resource.

Any loss of cultural or archaeological resources due to any aspect of the proposed action is irretrievable.

NO-LEASE ALTERNATIVE

There would be little change in the surface resources and their uses if present management continues. Geothermal exploration would continue around the Study Area. If a steam resource is found, production wells and power generation would follow. The Study Area could be impacted by geothermal access roads to the surrounding field. Because the surface area is privately owned the landowner could authorize other surface disturbing activities.

Some of the off-site effects of geothermal power production would affect the Study Area's environment. Air quality would decline with an increase in hydrogen sulfide concentration from new sources. Water quality may be affected from construction in the upper watersheds. Traffic would increase on the county roads near the Study Area.

With the exception of these off-site impacts, if this alternative is implemented and no development occurs, the existing surface environment of the Study Area would not be affected or altered and there would be no impacts. However, because the steam reservoir is fluid, it is likely that the steam that may be beneath the area would be drained by adjacent developments.

CHAPTER 5

PARTICIPATING STAFF

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CHAPTER 6

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A. Federal Agencies

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Office of Biological Services
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U.S. Bureau of Land Management
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B. State Agencies

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and Research
State Clearinghouse
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Sacramento, California 95814

State of California
California Regional Water
Quality Control Board
Central Valley Region
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State of California
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State of California
Energy Commission
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State of California
California Regional Water
Quality Control Board
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Sacramento, California 95811

State of California
Division of Oil and Gas
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Santa Rosa, California 95401

State of California
Water Resources Control Board
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Sacramento, California 95801

C. County Agencies

Lake County Planning Commission
County Courthouse Building
Lakeport, California 95453

Lake County Board of Supervisors
County Courthouse Building
Lakeport, California 95453

Sonoma County Library
Central Library
3rd and "E" Streets
Santa Rosa, California 95404

Lake County Library
Lakeport Library Building
200 Park
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Sonoma County Planning Commission
County Administration Building
Room 105A
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Air Pollution Control District
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Napa County Library
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Centinela Avenue and Teale Street
Culver City, California 90272

Pacific Gas and Electric Co.
77 Beale Street
San Francisco, California 94106

Sacramento Municipal Utility
District
620 "S" Street
Sacramento, California 95814

Northern California Power Agency
1400 Coleman Avenue, #G-27
Santa Clara, California 95050

F. Other Interested Parties

G.R.I.P.S. Commission
2628 Mendocino Avenue
Santa Rosa, California 95401

Dr. David Fredrickson
Department of Anthropology
Sonoma State University
1801 East Cotati Avenue
Rohnert Park, California 94928

Sierra Club
Attn: Hamilton Hess
255 Ursuline Road
Santa Rosa, California 95401

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APPENDIX A

LIST OF SENSITIVE PLANT SPECIES WHICH MAY OCCUR IN THE STUDY AREA

KEY TO RARE - THREATENED - ENDANGERED PLANTS
UKIAH DISTRICT, BUREAU OF LAND MANAGEMENT, UKIAH, CA

The Rarity-Endangerment-Vigor-Distribution Code

1/ from 5/

Rarity (R)

1. Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction or extirpation is low at this time.
2. Occurrence confined to several populations or to one extended population.
3. Occurrence limited to one or few highly restricted populations, or present in such small numbers that it is seldom reported.

Endangerment (E)

1. Not endangered
2. Endangered in a portion of its range
3. Endangered throughout its range

Vigor (V)

1. Increasing or stable in number
2. Declining in number
3. Approaching extinction or extirpation

Distribution (D)

1. More or less widespread outside California
2. Rare outside California
3. Endemic to California

2/ from 11/

2/ from 11/

Code	County	Planning Unit	Code
011	Colusa	King Range	01
015	Del Norte	Humboldt	02
021	Glenn	Red Mountain	03
023	Humboldt	East Mendocino	05
033	Lake	Cow Mountain	06
041	Marin	Russian River	07
045	Mendocino	East Lake	08
055	Napa	Putah Creek	09
095	Solano	Vallejo	10
097	Sonoma	Unknown	U.N.
103	Tehama	No data on file	N.D.
105	Trinity		
113	Yolo		
U.N.	Unknown		
*	Plant may be extirpated from that county		

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8/ E=Endangered, T=Threatened, S=Species of Concern
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**/ The 1975 and 1976 Federal lists were withdrawn on November 1979; however any species which was once the subject of a notice of review (1975) or proposed as threatened or endangered (1976) are considered as candidate species by the U.S. Fish and Wildlife Service until further notice.

RARE-THREATENED-ENDANGERED PLANTS

Plant Code 3/	Scientific Name/Common Name FAMILY	R-E-V-D Codes 1/	County Code 2/	Planning Unit Code 2/	STATE LIST 4/	CNPS LIST 5/	FEDERAL LISTS 1975		FEDERAL LISTS 1976	FEDERAL LISTS USFS Draft List 1980 8/	Flowering Period 9/	Habitat 9/ 10/
							T	E				
AMLU	Amainckia lunaris BORAGINACEAE	1-1-1-3	33,97	N.D.		3						Coast range of Cent. CA
ANSU-1	Antirrhinum subcordatum Dimorphic snapdragon SCROPHULARIACEAE	2-2-2-3	11,21, 33,103	10,06,08		2	X			T	June-July	Chaparral. Rare, apparently on serpentine
ANVI-2	Antirrhinum virga SCROPHULARIACEAE	1-1-1-3	33,45, 97	09		3					June-July	Open grsvelly and rocky plsces below 3500 feet Chaparrsl, N. Oak Wd.
ASSO	Aaclepiss solsnoans ASCLEPIADACEAE	1-1-1-3	11,33, 55,97, 103,105	05 08 09		3					June	Dry, serpentine outcropping 2000-5000 ft.; Yellow Pine Forest
ASCL-1	Astragalus clarianus Clara Hunt's rattleweed FABACEAE	3-2-3-3	33,55, 97 *	09		2		X	X	E	April-May	Grassy hillsides 300-500 ft. In thin volcanic clay or serpentine soils that are moist in the spring. Foothill Wd.
BRCOR	Broadiaea coronaria ssp. rosea Indian Valley brodiaea AMARYLLIDACEAE	3-3-2-3	33,103	08	E	3				E	May-July	Open, sunny places in clay derived from serpentine. Northern Oak Wd.

SEE KEY FOR REFERENCES

RARE-THREATENED-ENDANGERED PLANTS

Plant Code 3/	Scientific Name/Common Name FAMILY	R-E-V-D Codes 1/	County Code 2/	Planning Unit Code 2/	STATE LIST 4/	CNPS LIST 5/	FEDERAL LISTS 1975		1976	USFS Draft List 1980 8/	Flowering Period 9/	Habitat 9/ 10/
							T	E				
CECO-3	Ceanothus confusus Rincon ceanothus RHAMNACEAE	3-2-1-3	97	09, 10		2				T	February-April May-June (fruiting)	Serpentine soil. Serpentine Chaparral.
CEDI-2	Ceanothus divergens Mount St. Helena ceanothus RHAMNACEAE	2-1-1-3	33, 55, 97	09, 10		2				T	February-March	Chaparral and Foothill Wd. U. Napa Valley, mostly near Calistoga.
COTEC	Cordylanthus tenuis ssp. capillaris Pennel bird's beak SCROPHULARIACEAE	2-2-1-3	97	07, 09	R	2			X	T	July-August	Often on serpentine. Chaparral, Foothill Wd.
CUHO	Cuscuta howelliana Boggs' Lake dodder CUSCUTACEAE	1-1-1-3	33, 97, 103	09		3		X	X		June	Drying vernal pool.
DILAT	Dichanthelium lanuginosum thermale Geyser's panicum POACEAE	3-2-1-3	55, 97	08, 09, 10	E	2			X	E	June-August	Wet saline places about hot springs.
ERBR-1	Eriastrum brandegeae Brandegee eriastrum POLEMONIACEAE	3-2-2-3	11, 33	N.D.		2				E	May-August	Volcanic material, chaparral, Foothill Wd. Mts. of Lake Co.
ERCA-2	Eriogonum caninum Tiburon wild buckwheat POLYGONACEAE	1-2-1-3	33, 41, 55, 97*	09		3			X		June-September	Dry rocky slopes on shale and serpentine, 1000-2000 ft. Coastal Prairie, Marin Co., and the Oakland Hills, Contra Costa Co.
	SEE KEY FOR REFERENCES											

R A R E - T H R E A T E N E D - E N D A N G E R E D   P L A N T S

Plant Code 3/	Scientific Name/Common Name FAMILY	R-E-V-D Codes 1/	County Code 2/	Planning Unit Code 2/	STATE LIST 4/	CNPS LIST 5/	FEDERAL LISTS 1975		FEDERAL LISTS 1976	USFS Draft List 1980 8/	Flowering Period 9/	Habitat 9/ 10/
							T	E				
ERNE-4	Eriogonum nervulosum Snow Mountain buckwheat POLYGONACEAE	2-1-1-3	11,21,33 97	08,09		2				S	June - September	Serpentine barrens, Mayacmas Mountain, southwestern Lake Co.; stony places, Red Fir Forest, Snow Mt., Lake Co.
FREA	Fritillaria eastwoodiae Butte fritillaria LILIACEAE	1-2-1-3	55	N.D.		3				T	March - June	Dry slopes; Chaparral, Foothill wd. Butte and Napa Co.
FRPL-2	Fritillaria pluriflora Adoby Lily LILIACEAE	1-2-1-3	11,21, 33,55, 95,113	08 09 10		3	X			S	Feb. - April	Adobe soil of interior foothills below 1500 ft. Foothill wd.
FRPU-3	Fritillaria purdyi Purdy's fritillary LILIACEAE	1-1-1-3	11,23, 33,45, 55,103, 105	05 09		3					March - June	Serpentine ridges 1400-6900 feet., Chaparral, Yellow Pine F., Foothill wd.
GRHE	Gratiola heterosepala Boggs Lake hedge - hyssop SCROPHULARIACEAE	3-3-2-3	33	09	E	2		X	X	T	April - June	At 2900 ft. Boggs Lake, Lake Co.
HEEX	Helianthus exilis Serpentine sunflower ASTERACEAE	2-2-2-3	33,55, 103,105	08,09		2		X		T	July - November	Serpentine outcrops in the foothills up to 5000 ft. and a ruderal on V. floors. V. grassland up to Yellow Pine F.
HEAD	Hesperolinon adenophyllum Glandular dwarf flax LINACEAE	1-1-1-3	23*, 33 45	02,05,06,07,08 09,10		3	X			S	June - July	Dry brushy hills and woods at least on serpentine 1500-4500 ft. chaparral, N. oak wd.

SEE KEY FOR REFERENCES

RARE-THREATENED-ENDANGERED PLANTS

Plant Code 3/	Scientific Name/Common Name FAMILY	R-E-V-D Codes 1/	County Code 2/	Planning Unit Code 2/	STATE LIST 4/	CNPS LIST 5/	FEDERAL LISTS 1975		FEDERAL LISTS 1976	FEDERAL LISTS USFS Draft List 1980 8/	Flowering Period 9/	Habitat 9/ 10/
							T	E				
HEBI-2	Heaperolinon bicarpellatum Two carpel flax LINACEAE	1-1-1-3	33,55	08,09,10		3	X			S	May - June	Clay and serpentine brushy slopes and open woods. Ca. 1200-1500 ft. chaparral, foothill wd.
HEDI-1	Hesperolinon didymocarpum Lake Co. dwarf flax LINACEAE	3-2-2-3	33	09	E	2		X	X	E	May - June	Serpentine
HEDR	Hesperolinon drymarioides Drymaria dwarf flax LINACEAE	2-1-1-3	11,21, 33	08		2	X			S	July - August	Rare on dry slopes Ca. 2500 ft. Foothill wd.
LABU	Laathenia burkei Burke's baeria ASTERACEAE	3-3-2-3	33*,45*, 97	09	E	2		X	X	E	April - May	Vernal pools and wet meadows. Low sunny flats, drying borders of vernal pools.
LELI	Legenere limosa Legenere CAMPANULACEAE	3-3-3-3	33,55, 95,97*	10		2		X	X	E	May - June	Dried beds of vernal pools. V. graasland
LORE	Lomatium repoatum UMBELLIFERAE	1-1-1-3	33,55, 95,97	09		3					April - May	Chaparral, closed-cone pine F., Foothill wd.
LUSE	Lupinus aericatus Cobb Mtn. lupine FABACEAE	1-1-1-3	33,55 97	09,10		3	X				April - June	Open wooded slopes 2000-4000 ft. Yellow Pine F. Mixed Evergreen F.
NAPA	Navarretia pauciflora Few-flowered navarretia POLEMONIACEAE	2-2-1-3	33	08,09		2		X	X	T	June	Vernal pools in volcanic rubble. Chaparral.
	SEE KEY FOR REFERENCES											

R A R E - T H R E A T E N E D - E N D A N G E R E D   P L A N T S

Plant Code 3/	Scientific Name/Common Name FAMILY	R-E-V-D Codes 1/	County Code 2/	Planning Unit Code 2/	STATE LIST 4/	CNPS LIST 5/	FEDERAL LISTS 1975		FEDERAL LISTS 1976	FEDERAL LISTS USFS Draft List 1980 8/	Flowering Period 9/	Habitat 9/ 10/
NAPL	Navarretia plieantha Many flowered navarretia POLEMONIACEAE	3-2-1-3	33,97	09	E	2	T	E X	X	T	May-June	Peaty margin of Boggs Lake at 3000 ft. Yellow Pine F.
ORTE	Orcuttia tenuis Slender orcuttia POACEAE	3-3-2-3	33,103	09,10	E	2		X	X	E	May-July	Vernal pools. V. grassland. Foothill wd.
PALE	Parvisedum leiocarpum Lake Co. stonecrop CRASSULACEAE	2-2-2-3	33	08,09		2		X	X	T	April-May	Dry rocky places and vernal pools. Chaparral
PEGAG	Perideridia gairdneri ssp. gairdneri Gairdner's yampah APIACEAE	2-2-2-3	41*,55 95,97	09		2				T	June-July	Wet places below 11,000 ft. Many plant communities. Cismontane and montane Ca.
PODOP	Pogogyne douglasii ssp. parviflora LAMIACEAE	2-1-1-3	33,45, 97	05 07 10		2		X	X	S		Low places. Mixed evergreen F. N. Oak wd. Valleys in coast ranges.
SIORH	Sidalcea oregana ssp. hydrophila MALVACEAE	2-1-1-3	21,33 55	07,09		2	X			S	July-August	Mixed evergreen F. Yellow Pine F.
STBR-2	Streptanthus brachiatus Contact Mine streptanthus BRASSICACEAE	3-2-1-3	97	09		2	X			T	June June-July (fruiting)	Serpentine outcrops east of Pine Flat.
STMO	Streptanthus morrissonii Morrison's jewel flower BRASSICACEAE	2-2-1-3	33,55 97	07		2	X			T		Serpentine.
TRRO	Tracyina rostrata Beaked tracyina ASTERACEAE	3-1-1-3	23,33	02,06	T	2		X	X	T	May-June	Dry grassy slopes 400-1000 ft. Coastal prairie.

APPENDIX B

Cultural Resource Site Descriptions

A total of twelve archaeological sites have been recorded within the proposed lease blocks. following are general site descriptions:

CA-LAK-1116: A moderately dense scatter of utilized obsidian flakes and debitage situated on an open, flat grassy area about 100 meters south of a tributary of Kelsey Creek.

CA-LAK-1117: A light scatter of obsidian debitage situated on the north side of a gently sloping hill.

CA-LAK-1118: A light scatter of obsidian flakes and one artifact situated on flat, relatively open area directly to the south of a tributary of Kelsey Creek.

CA-LAK-1124: An extensive scatter of obsidian flakes and artifacts situated on an open saddle about 1000 meters south of Sweetwater Creek.

CA-LAK-1125: A moderate scatter of relatively large obsidian flakes situated in a moderately open cypress forest with a minor seasonal water course which fans across the site north to south.

CA-LAK-1126: A sparse scatter of obsidian flakes situated in a generally level area with an east and southeast exposure.

CA-LAK-1127: A sparse scatter of obsidian flaking debris situated on a dirt road in an area of moderately dense chaparral.

CA-LAK-1128: A sparse to moderate scatter of obsidian flakes and two handstone fragments situated on a ridgetop with an eastern exposure.

CA-LAK-1129: A moderate to dense scatter of obsidian flakes situated on a wide flat in an area of comparatively open manzanita chaparral.

CA-LAK-1130: A sparse to moderate scatter of obsidian flakes situated on an oval hilltop in an area of sparse to moderate chaparral.

CA-LAK-1131: A moderate to dense scatter of obsidian flakes and artifacts situated on a flat and gradual, south-facing slope.

CA-LAK-1132: A scatter of obsidian flakes and artifacts situated on a gently sloping, narrow area of the ridgetop in an area of sparse to moderately dense chaparral.

APPENDIX C

VISUAL RESOURCE CONTRAST RATINGS

GEOTHERMAL ACTIVITIES

Contrast Rating

The degree to which a management activity adversely affects the visual quality of the landscape depends upon the amount of visual contrast that is created between the activity and the existing landscape character. The amount of contrast can be measured by separating the landscape into its major features (land and water, vegetation, and structures), and then predicting the magnitude of change in contrast of each of the basic elements (form, line, color, and texture) to each of the features. Assessing the amount of contrast for a proposed activity in this manner will indicate the severity of impact and serve as a guide in determining what is required to reduce the contrast to the point where it will meet the visual management classes requirement for the area.

The contrast rating quickly reveals the elements and features that will cause the greatest visual impact. Those elements with the highest degree of contrast are the ones that can be most easily identified, and often offer the most opportunity to reduce visual impact.

Management Classes

The determination of the visual resource management classes for a particular landscape is based on the three inventory variables (scenic quality, visual sensitivity, and distance zones) and their various combinations in order to establish management objectives. For the Kelsey Creek study area the landscape falls within the VRM Classes II and III.

The following descriptions are for the management classes applicable to the Kelsey Creek study area.

Class II - changes in any of the basic elements (form, line, color, and texture) created by a management activity should not be evident in the characteristic landscape. Contrasts are seen but must not attract attention.

Class III - changes in any of the basic elements (form, line, color, and texture) caused by a management activity may be evident in the characteristic landscape. However, contrasts should remain subordinate to the existing landscape and should borrow from the basic elements characteristic to the surrounding landscape.

In addition to these management class descriptions, the contrast rating system further stipulates the following limits of allowable contrasts.

Class II - the degree of contrast for any one element should not exceed a moderate value (2X) and the total contrast rating for any feature may not exceed 12.

Class III - the degree of contrast for any one element should not exceed a moderate value (2X), and the total contrast rating for any feature may not exceed 16.

Worksheets

For the Kelsey Creek study area, five geothermal activities were evaluated using the contrast rating system. The activities include roads, well pads, steam lines, power generating plants, and transmission lines. All activities were evaluated for typical locations within the Class III visual resource lands in the study area. Well pads and power generating plants were also evaluated for the Class II lands on the Binkley tract as can be seen from Bottlerock Road.

The worksheets describe the characteristic landscape and the management activity as proposed. The contrast rating evaluation reveals the degree of contrast of the proposed activity. If the contrast exceeds the allowable amount for the management class, the activity is reevaluated incorporating stipulations and mitigation measures to determine, if with modification, the activity can meet management objectives.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SCENIC QUALITY FIELD INVENTORY

Date 15 DECEMBER 1980
District UKIAH
Planning unit CLEARLAKE
Scenic quality rating unit
GEYSERS/CALISTOGA KGRA

1. Evaluators *(names)*

J.S.FOSTER

2. LANDSCAPE CHARACTER *(Feature)*

	a. LANDFORM/WATER	b. VEGETATION	c. STRUCTURE *(General)*
FORM	STEEP ROLLING HILLS DISSECTED by SHARPLY DEFINED DRAINAGE PATTERS	MOSTLY ROUNDED or with SLIGHT UNDULATION w/ SOME GEO. JAGGED	* NOT DOMINANT or ONLY SLIGHTLY EVIDENT in the LANDSCAPE *
LINE	UNDULATING, IRREGULAR and SOMEWHAT ROUNDED RIDGELINES APPEARING in SERIES BELOW the HORIZON.	UNDULATING at EDGES of VEGETATION TYPES OTHERWISE not DOMINANT.	
COLOR	SOILS RANGE from TAN to REDDISH TAN OVERALL BACKGROUND COLOR TENDS to GREYISH GREEN - MUTED	SPECIES COLOR RANGES from GREYISH GREEN to YELLOWISH GREEN	
TEXTURE	MODERATE UNIFORM or EVEN TEXTURE in FG/MG VIEWS TENDING TOWARDS COARSE TEXTURE for DISTANT VIEWS	MED to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES w/ LOWER SLOPES MORE RANDOM	

3. Narrative

LOW COASTAL MOUNTAINS/FOOTHILLS with STEEP SLOPES and NUMEROUS DRAINAGES. RIDGELINES OCCUR in UNDULATING SERIES with DOMINANT/MAJOR RIDGELINES on the HORIZON. MIXED CHAPARRAL SPECIES INTERSPERSED with few EVERGREEN STANDS (mosty KNOBCONES). SOILS tend to TAN or REDDISH TAN (Serpentine soils)

4. SCORE *(Circle Appropriate Level)* *

	HIGH	MEDIUM	LOW	EXPLANATION OR RATIONALE
a. Landform	5	[✓ 3]	1	Steep Hills w/ Interesting Patterns
b. Vegetation	5	[✓ 3]	1	Variety within Types of Veg.
c. Water	5	3	[✓ 1] 0	Influence of Water Evident in Valleys
d. Color	5	3 [✓ 2]	1	Some Color Variety, soil contrast
e. Influence	5	[✓ 3]	0	Adjacent Scenery Enhances Site
f. Scarcity	6	2	[✓ 1]	Common within Region
g. Cultural Modification	2 [✓ 1]	0	-4	Not Evident in Landscape
TOTALS	1	+ 11	+ 2 =	14

SCENIC QUALITY CLASSIFICATION

☐ Class A – 19–33
☒ Class B – 12–18
☐ Class C – 11 or less

* *See Scenic Quality Rating Criteria in BLM Manual Section 8411*

Form 8400–1 (September 1978)
U.S. Government Printing Office-1978-779-309/.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 15 DECEMBER 1980

District UKIAH

Planning unit CLEARLAKE/GEYSERS KERA

Activity KELSEY-CREEK GEOTHERMAL

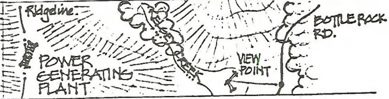
SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
GENERATING PLANT	BOTTLEROCK RD.	CLASS II

4a. LOCATION

TOWNSHIP	RANGE	SECTION
T12N	R9W	25,26

b. LOCATION MAP



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

1. LAND/WATER	FORM	STEEP ROLLING HILLS DISSECTED BY SHARPLY DEFINED DRAINAGES
	LINE	UNDULATING, IRREGULAR and ROUNDED RIDGELINES at HORIZON APPEARING in SERIES. SHARP CONVERGENCE then DRAWN OUT in VALLEYS
	COLOR	SOILS RANGE from TAN to REDDISH TAN OVERALL BACKGROUND COLOR TENDS to DARK GREYISH GREENS - MUTED COLORS
	TEXTURE	FINELY GRAINED FOREGROUND BECOMING MODERATE to COARSE in the BACKGROUND where LANDFORMS are MORE IRREGULAR
2. VEGETATION	FORM	MOSTLY ROUNDED or with SLIGHT UNDULATION. CONIFER AREAS SHOW MORE VERTICAL RELIEF with JAGGED/GEOMETRIC FORMS
	LINE	UNDULATING at EDGES of SPECIES MIX and CHANGES OTHERWISE NOT EVIDENT
	COLOR	COLORS RANGE from GREYISH GREEN to YELLOWISH GREENS with SEASONAL CHANGES & DISTANCE VARIATION from BRIGHT to MUTED
	TEXTURE	MEDIUM to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES and MORE RANDOM TEXTURE on LOWER SLOPES
3. STRUCTURES	FORM	* NONE or NOT EVIDENT *
	LINE	
	COLOR	
	TEXTURE	

(Continued on page 2)

Form 8400-4 (September 1978)
U.S. Government Printing Office - 78-779-312

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	FLATTED to LEVEL PAD with ANGULAR FORMS at CUTS and FILLS
	LINE	RECTILINEAR and ANGULAR — DISCONTINUOUS
	COLOR	TAN to REDDISH TAN
	TEXTURE	FINE GRAINED to UNEVEN and COARSE
2. VEGETATION	FORM	INTERRUPTED PATTERN and LOSS of NATURAL VEG. FORMS
	LINE	HORIZONTAL DISRUPTIONS
	COLOR	TAN to REDDISH TAN (SOIL EXPOSED due to VEG. LOSS)
	TEXTURE	INTERRUPTED to FINE and UNEVEN TEXTURE
3. STRUCTURES	FORM	LONG, RECTILINEAR FORMS w/ CYLINDRICAL TOWERS
	LINE	RECTILINEAR w/ PROMINENT HORIZONTALS, and PARABOLIC VERT.
	COLOR	GREY to WHITE
	TEXTURE	SMOOTH to METALLIC

SECTION D. CONTRAST RATING ☐ SHORT TERM ☑ LONG TERM

DEGREE OF CONTRAST	FEATURES											
	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS Form (4x)	12	[✓ 8]	4	0	12	[✓ 8]	4	0	[✓ 12]	8	4	0
Line (3x)	9	[✓ 6]	3	0	9	[✓ 6]	3	0	[✓ 9]	6	3	0
Color (2x)	[✓ 6]	4	2	0	[✓ 6]	4	2	0	[✓ 6]	4	2	0
Texture (1x)	3	[✓ 2]	1	0	3	[✓ 2]	1	0	3	[✓ 2]	1	0
TOTALS	22				22				29			

1a. Maximum element contrast

CLASS II = MODERATE

b. Maximum feature contrast

CLASS II = 12

2. Does project design meet visual resource management requirements? ☐ Yes ☑ No
If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.

Evaluator *(signature)* Jonathan S. Foster

Date 15 DEC 1980

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

LANDFORM: 1. RESTRICT EARTHWORK to MINIMUM NECESSARY for SITING of GENERATING FACILITY. NO MAJOR CUTS and FILLS.
2. ROUND SLOPES on ALL CUTS and FILLS, and BLEND with EXISTING TOPOGRAPHY.
3. USE BERMS to HELP REDUCE APPARENT SCALE of POWER PLANT

VEGETATION 1. KEEP CLEARING to MINIMUM and LEAVE IRREGULAR EDGES.
2. REVEGETATE ALL DISTURBED AREAS with NATIVE PLANTS and REPLANT to COMPLIMENT NATURAL VEG. PATTERNS.

STRUCTURES 1. NO STRUCTURE SHALL BREAK the SKYLINE above RIDGE TOPS. STRUCTURES SHOULD HAVE BACKDROP of LANDSCAPE
2. STRUCTURES WILL BE ARRANGED in COMPACT CONFIGURATION
3. COLORS CHOSEN TO BLEND with SITE CONDITIONS. NON REFLECTIVE
4. REDUCE HEIGHT of ALL STRUCTURES

SECTION F. DESCRIPTION OF ACTIVITY *(Redesigned)*

1. LAND/WATER	FORM	FLATTENED to ROUNDED
	LINE	HORIZONTAL, BLENDING with EXISTING TOPOGRAPHY with NO ABRUPT TRANSITIONS.
	COLOR	TAN to REDDISH TAN PATCHES in GREYISH GREEN COVER.
	TEXTURE	FAIRLY UNIFORM with PATCHES of SMOOTH TEXTURE at EXCAVATED AREAS.
2. VEGETATION	FORM	INTERRUPTED PATTERN
	LINE	IRREGULAR EDGES at CLEARINGS; SOFT EDGE TRANSITIONS BETWEEN EXISTING VEGETATION and CLEARINGS & REVEG. AREAS.
	COLOR	GREY GREENS with PATCHES of TAN to REDDISH TANS
	TEXTURE	UNEVEN; SMOOTH, FINE GRAINED AREAS INTERSPERSED in MORE MODERATE to COARSE TEXTURED AREAS
3. STRUCTURES	FORM	LOW, RECTILINEAR, BLOCK FORMS w/ CYLINDRICAL TOWERS
	LINE	HORIZONTAL w/ PROMINENT PARABOLIC VERTICALS
	COLOR	MUTED, DARK TONES THAT BLEND with LOCAL SITE CONDITIONS. NON REFLECTIVE PAINT
	TEXTURE	FLAT, MATTE

(Continued on page 4)

SECTION G. CONTRAST RATING *(Redesigned)*

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	[✓ 8]	4	0	12	8	[✓ 4]	0	12	[✓ 8]	4	0
	Line (3x)	9	6	[✓ 3]	0	9	6	[✓ 3]	0	9	6	[✓ 3]	0
	Color (2x)	6	4	[✓ 2]	0	6	[✓ 4]	2	0	6	4	[✓ 2]	0
	Texture (1x)	3	2	[✓ 1]	0	3	2	[✓ 1]	0	3	2	[✓ 1]	0
TOTALS		14				12				14			

1a. Maximum element contrast

CLASS II = MODERATE

b. Minimum feature contrast

CLASS II = 12

2. Does project design meet visual resource management requirements? ☐ Yes ☒ No

If "no," request services of district landscape architect, and describe amount of time and when required.

3. Fiscal year

19

4. Which third? *(check one)*

☐ First ☐ Second ☐ Third

5. TIME REQUIRED

DAYS	MAN-MONTHS

SECTION H. RECOMMENDATIONS

1. Recommendation of staff landscape architect if allowable contrast rating cannot be met

EVEN with SITE SPECIFIC MITIGATION MEASURES, the SIZE and OVERALL CONTRAST of A GENERATING PLANT and AMOUNT of LANDFORM MODIFICATION NECESSARY for SITING WOULD RESULT in an INTRUSION with CONTRASTS EXCEEDING the ALLOWABLE BASED on VRM OBJECTIVES for CLASS II LANDS.

NO SURFACE DISTURBANCE is RECOMMENDED for CLASS II VISUAL RESOURCE LANDS.

Signature Jonathan S. Foster

Date 15 DEC. 1980

2. Decision and justification of Area or District Manager

Signature

Date

3. Check appropriate box: ☐ Proceed with project/activity as mitigated ☐ Cancel project/activity as proposed

Signature

Date

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 15 DECEMBER 1980

District UKIAH

Planning unit CLEARLAKE/GEYSERS KGRA

Activity KELSEY-CREEK GEOTHERMAL

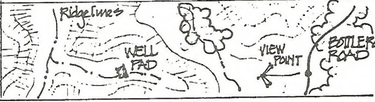
SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
WELL PAD	BOTTLEROCK RD	CLASS II

4a. LOCATION

TOWNSHIP	RANGE	SECTION
T12N	R9W	25,26

b. LOCATION MAP



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

1. LAND/WATER	FORM	STEEP ROLLING HILLS DISSECTED BY SHARPLY DEFINED DRAINAGES
	LINE	UNDULATING, IRREGULAR and ROUNDED RIDGELINES at HORIZON APPEARING in SERIES. SHARP CONVERGENCE then DRAWN OUT in VALLEYS
	COLOR	SOILS RANGE from TAN to REDDISH TAN. OVERALL BACKGROUND COLOR TENDS to DARK GREYISH GREENS - MUTED COLORS
	TEXTURE	FINELY GRAINED FOREGROUND BECOMING MODERATE to COARSE in the BACKGROUND where LANDFORMS are MORE IRREGULAR
2. VEGETATION	FORM	MOSTLY ROUNDED or with SLIGHT UNDULATION. CONIFER AREAS SHOW MORE VERTICAL RELIEF with JAGGED/GEOMETRIC FORMS
	LINE	UNDULATING at EDGES of SPECIES MIX and CHANGES OTHERWISE NOT EVIDENT
	COLOR	COLORS RANGE from GREYISH GREEN to YELLOWISH GREENS with SEASONAL CHANGES & DISTANCE VARIATION from BRIGHT to MUTED
	TEXTURE	MEDIUM to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES and MORE RANDOM TEXTURE on LOWER SLOPES
3. STRUCTURES	FORM	* NONE or NOT EVIDENT *
	LINE	
	COLOR	
	TEXTURE	

(Continued on page 2)

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SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	STEEP ROUNDED FORMS INTERRUPTED BY FLAT LEVEL PADS
	LINE	REGULAR/HORIZONTAL amongst UNDULATING SERIES of RIDGE-LINES
	COLOR	REDDISH TAN SOIL EXPOSED by CUTS and FILLS
	TEXTURE	FINE, UNIFORM GRAIN
2. VEGETATION	FORM	GEOMETRIC CLEARINGS in fairly UNIFORM SURFACE COVER and NATURAL PATTERNS
	LINE	SHARP, RECTILINEAR, and/or UNNATURAL LINE at EDGES of CLEARINGS
	COLOR	LOSS of VEGETATION RESULTS in EXPOSURE of BARE SOIL
	TEXTURE	FINE - EXPOSED to BARE SOIL
3. STRUCTURES	FORM	VERTICAL, MANMADE FORMS TENDING TOWARDS DIAGONAL TRACERY
	LINE	VERTICAL and TRIANGULAR
	COLOR	GREY to RED and/or ORANGE
	TEXTURE	SMOOTH METALLIC

SECTION D. CONTRAST RATING ☐ SHORT TERM ☑ LONG TERM

DEGREE OF CONTRAST	FEATURES											
	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS Form (4x)	[✓ 12]	8	4	0	12	[✓ 8]	4	0	12	[✓ 8]	4	0
Line (3x)	9	[✓ 6]	3	0	9	[✓ 6]	3	0	9	[✓ 6]	3	0
Color (2x)	[✓ 6]	4	2	0	[✓ 6]	4	2	0	[✓ 6]	4	2	0
Texture (1x)	3	[✓ 2]	1	0	[✓ 3]	2	1	0	3	[✓ 2]	1	0
TOTALS	26				23				26			

1a. Maximum element contrast

CLASS II = MODERATE

b. Maximum feature contrast

CLASS II = 12

2. Does project design meet visual resource management requirements? ☐ Yes ☑ No *If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.*

Evaluator *(signature)* Jonathan S. Foster

Date 15 DEC 80

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

LANDFORM 1. PADS SHOULD BE LOCATED in AREAS with TENDENCIES TOWARDS FLAT LEVEL TERRAIN to MINIMIZE CUTS and FILLS. AVOID PROMINENT RIDGETOPS

2. ROUND SLOPES on ALL CUTS and FILLS, and BLEND with EXISTING TOPOGRAPHY.

VEGETATION 1. MINIMIZE CLEARING w/ EDGES FEATHERED and IRREGULAR to REDUCE SHARP CONTRASTS.

2. REVEGETATE DISTURBED AREAS with NATIVE PLANTS and USE LOW CONTRAST, DK. COLORED (LANDSCAPE COLORS and TONES fr SITE CONDITIONS) MULCHES/EMULSIONS

STRUCTURES. 1. ALL STRUCTURES PAINTED with DULL, NON-REFLECTIVE PAINTS. DARK COLORS SPECIFIED FOR SITE CONDITIONS.

2. LOCATE STRUCTURES BELOW SKYLINE WHERE POSSIBLE.

SECTION F. DESCRIPTION OF ACTIVITY *(Redesigned)*

1. LAND WATER	FORM	FLAT. LEVEL PADS with ROUNDED EDGES and SLOPES
	LINE	CONTINUOUS with SLIGHT HORIZONTAL DISRUPTIONS
	COLOR	EXPOSE SOIL. TAN to REDDISH TAN
	TEXTURE	FINE to MEDIUM GRAIN
2. VEGETATION	FORM	IRREGULAR OPENNINGS
	LINE	UNDULATING, IRREGULAR EDGES at CLEAR SOFT EDGE TRANSITION.
	COLOR	TAN to REDDISH TAN with SLOW TENDENC TOWARD GREYISH GREEN on REVEGETATED SLOPES. DK COLORED EMULSION/MULCH.
	TEXTURE	MED to FINE PATCHES in the EXISTING TEXTURE
3. STRUCTURES	FORM	TALL VERTICAL and ANGULAR FORMS. LOCATED BELOW RIDGELINE WHERE POSSIBLE.
	LINE	VERTICAL and TRIANGULAR
	COLOR	DK MUTED colors to MEET SITE CONDITIONS (GREYISH GREEN or BROWNISH GRN) NON-REFLECTIVE
	TEXTURE	FLAT, MATTE

(Continued on page 4)

SECTION G. CONTRAST RATING *(Redesigned)*

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY * (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	[✓ 8]	4	0	12	8	[✓ 4]	0	12	[✓ 8]	4	0
	Line (3x)	9	6	[✓ 3]	0	9	6	[✓ 3]	0	9	6	[✓ 3]	0
	Color (2x)	6	4	[✓ 2]	0	6	[✓ 4]	2	0	6	4	[✓ 2]	0
	Texture (1x)	3	2	[✓ 1]	0	3	2	[✓ 1]	0	3	2	[✓ 1]	0
TOTALS		14				12				14			

1a. Maximum element contrast

CLASS II = MODERATE

b. Minimum feature contrast

CLASS II = 12

2. Does project design meet visual resource management requirements? ☐ Yes ☑ No

If "no," request services of district landscape architect, and describe amount of time and when required.

3. Fiscal year

19

4. Which third? *(check one)*

☐ First ☐ Second ☐ Third

5. TIME REQUIRED

DAYS	MAN-MONTHS

SECTION H. RECOMMENDATIONS

1. Recommendation of staff landscape architect if allowable contrast rating cannot be met

EVEN with SITE SPECIFIC MITIGATION MEASURES IT IS UNLIKELY THAT GEOTHERMAL ACTIVITIES COULD BE ACCOMMODATED ON CLASS II VISUAL RESOURCE LANDS. THE AMOUNT of SURFACE DISTURBANCE WOULD RESULT IN CONTRASTS GREATER THAN THOSE ALLOWABLE BASED on VRM OBJECTIVES. NO SURFACE DISTURBANCE on CLASS II LANDS IS RECOMMENDED.

Signature Timothy D. Foster

Date 15 DEC. 1980

2. Decision and justification of Area or District Manager

Signature

Date

3. Check appropriate box: ☐ Proceed with project/activity as mitigated ☐ Cancel project/activity as proposed

Signature

Date

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 15 DECEMBER 1980

District UKIAH

Planning unit CLEARLAKE/GEYSERS KERA

Activity KELSEY-CREEK GEOTHERMAL

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
ROADS	TYPICAL	CLASS III

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T 12N	R9W	11, 13, 14 and 23, 24, 25 and 26	TYPICAL within STUDY AREA

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

1. LAND/WATER	FORM	STEEP ROLLING HILLS DISSECTED BY SHARPLY DEFINED DRAINAGES
	LINE	UNDULATING, IRREGULAR and ROUNDED RIDGELINES at HORIZON APPEARING in SERIES. SHARP CONVERGENCE then DRAWN OUT in VALLEYS.
	COLOR	SOILS RANGE from TAN to REDDISH TAN. OVERALL BACKGROUND COLOR TENDS to DARK GREYISH GREENS - MUTED COLORS
	TEXTURE	FINELY GRAINED FOREGROUND BECOMING MODERATE to COARSE in the BACKGROUND where LANDFORMS are MORE IRREGULAR
2. VEGETATION	FORM	MOSTLY ROUNDED or with SLIGHT UNDULATION. CONIFER AREAS SHOW MORE VERTICAL RELIEF with JAGGED/GEOMETRIC FORMS
	LINE	UNDULATING at EDGES of SPECIES MIX and CHANGES OTHERWISE NOT EVIDENT
	COLOR	COLORS RANGE from GREYISH GREEN to YELLOWISH GREENS with SEASONAL CHANGES & DISTANCE VARIATION from BRIGHT to MUTED
	TEXTURE	MEDIUM to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES and MORE RANDOM TEXTURE on LOWER SLOPES
3. STRUCTURES	FORM	* NONE or NOT EVIDENT *
	LINE	
	COLOR	
	TEXTURE	

(Continued on page 2)

Form 8400-4 (September 1978)
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SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	SLIGHT LINEAR DEPRESSION in LANDFORM w/ ANGULAR FORMS at CUTS and FILLS	
	LINE	STRAIGHT, LINEAR, UNNATURAL DISRUPTION	
	COLOR	TAN to REDDISH TAN	
	TEXTURE	FINE GRAINED to SMOOTH TEXTURE in LINEAR PATTERN	
2. VEGETATION	FORM	INTERRUPTED FORM and PATTERN due to VEGETATIVE LOSS/ROUNDED FORM in LINEAR PATTERN	
	LINE	INTRODUCED LINEAR PATTERN w/ STRONG, SHARP EDGES due to CLEARING	
	COLOR	TAN to REDDISH TAN	
	TEXTURE	FINE to SMOOTH GRAIN DISRUPTING EXISTING TEXTURE	
3. STRUCTURES	FORM	NONE EVIDENT or NOT DOMINANT	RECTILINEAR or ANGULAR
	LINE	EXCEPT OCCASSIONAL BRIDGES, RETAINING WALLS, and/or DRAINAGE STRUCTURES	HORIZONTAL
	COLOR		GREY GALVANIZED STEEL/CONCRETE
	TEXTURE		SMOOTH METALLIC

SECTION D. CONTRAST RATING ☐ SHORT TERM ☐ LONG TERM

DEGREE OF CONTRAST	FEATURES											
	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS Form (4x)	12	[✓ 8]	4	0	[✓ 12]	8	4	0	12	8	[✓ 4]	0
Line (3x)	9	[✓ 6]	3	0	[✓ 9]	6	3	0	9	6	[✓ 3]	0
Color (2x)	6	[✓ 4]	2	0	[✓ 6]	4	2	0	6	[✓ 4]	2	0
Texture (1x)	3	2	[✓ 1]	0	3	[✓ 2]	1	0	3	2	[✓ 1]	0
TOTALS	19				29				12			

1a. Maximum element contrast

CLASS III = MODERATE

b. Maximum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☐ Yes ☐ No *If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.*

Evaluator *(signature)* Jonathan S. Foster

Date 15 DEC 1980

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

LANDFORM 1. RELOCATE ROAD to COMPLIMENT and MAXIMIZE EXISTING TOPOGRAPHY and REDUCE CUTS and FILLS
2. ROUND SLOPES on ALL CUTS and FILLS, and BLEND w/EXISTING TOPOGRAPHY

VEGETATION 1. MINIMIZE CLEARING TO WIDTH NECESSARY for ROAD
2. LEAVE IRREGULAR EDGES and NATURAL PATTERNS as in EXISTING LANDSCAPE for ALL CLEARINGS
3. REVEGETATE ALL DISTURBED AREAS w/ NATIVE VEGETATION. ON STEEP SLOPES PROVIDED PLANTING POCKETS, BENCHES, and/or SERRATIONS for PLANTINGS/SEEDS

STRUCTURES 1. USE NATURAL MATERIALS where POSSIBLE. COLOR to BLEND w/ LANDSCAPE

SECTION F. DESCRIPTION OF ACTIVITY *(Redesigned)*

1. LAND WATER	FORM	ROUNDED SLOPES
	LINE	CURVILINEAR
	COLOR	TAN /REDDISH TAN - DK MUTED GREEN MULCHES /EMULSIONS
	TEXTURE	SMOOTH
2. VEGETATION	FORM	ROUNDED w/ SOFT LINEAR ~~EDGE~~ TRANSITION to SMOOTH at CLEARINGS
	LINE	SOFT LINEAR EDGES at CLEARINGS
	COLOR	REVEG. SLOPES LT. GREEN w/ TEMP. MULCH /EMULSION DK. GRN.
	TEXTURE	MODERATE to FINE GRAINED, SMOOTH TEXTURE
3. STRUCTURES	FORM	VARIES to COMPLIMENT LANDSCAPE
	LINE	CURVILINEAR or HORIZONTAL
	COLOR	DK. MUTED GREY GRNS and DK. BROWNS. NON REFLECTIVE
	TEXTURE	FLAT

(Continued on page 4)

SECTION G. CONTRAST RATING *(Redesigned)*

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	8	[✓ 4]	0	12	8	[✓ 4]	0	12	8	[✓ 4]	0
	Line (3x)	9	6	[✓ 3]	0	9	[✓ 6]	3	0	9	6	[✓ 3]	0
	Color (2x)	6	4	[✓ 2]	0	6	4	[✓ 2]	0	6	4	[✓ 2]	0
	Texture (1x)	3	2	[✓ 1]	0	3	2	[✓ 1]	0	3	2	[✓ 1]	0
TOTALS		10				13				10			

1a. Maximum element contrast

CLASS III = MODERATE

b. Minimum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☒ Yes ☐ No

If "no," request services of district landscape architect, and describe amount of time and when required.

3. Fiscal year

19

4. Which third? *(check one)*

☐ First ☐ Second ☐ Third

5. TIME REQUIRED

DAYS	MAN-MONTHS

SECTION H. RECOMMENDATIONS

1. Recommendation of staff landscape architect if allowable contrast rating cannot be met

Signature

Date

2. Decision and justification of Area or District Manager

Signature

Date

3. Check appropriate box: ☐ Proceed with project/activity as mitigated ☐ Cancel project/activity as proposed

Signature

Date

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 15 DECEMBER 1980
District UKIAH
Planning unit CLEARLAKE/GEYSERS KERA
Activity KELSEY·CREEK GEOTHERMAL

SECTION A. PROJECT INFORMATION

1. Project name WELL PADS	2. Critical viewpoint number TYPICAL	3. MFP Step III VRM class CLASS III

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T 12 N	R9W	11, 13, and 14 and 23, 24, 25 and 26	TYPICAL within STUDY AREA

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

1. LAND/WATER	FORM	STEEP ROLLING HILLS DISSECTED BY SHARPLY DEFINED DRAINAGES
	LINE	UNDULATING, IRREGULAR and ROUNDED RIDGELINES at HORIZON APPEARING in SERIES. SHARP CONVERGENCE then DRAWN OUT in VALLEYS.
	COLOR	SOILS RANGE from TAN to REDDISH TAN. OVERALL BACKGROUND COLOR TENDS to DARK GREYISH GREENS - MUTED COLORS
	TEXTURE	FINELY GRAINED FOREGROUND BECOMING MODERATE to COARSE in the BACKGROUND where LANDFORMS are MORE IRREGULAR
2. VEGETATION	FORM	MOSTLY ROUNDED or with SLIGHT UNDULATION. CONIFER AREAS SHOW MORE VERTICAL RELIEF with JAGGED/GEOMETRIC FORMS
	LINE	UNDULATING at EDGES of SPECIES MIX and CHANGES OTHERWISE NOT EVIDENT
	COLOR	COLORS RANGE from GREYISH GREEN to YELLOWISH GREENS with SEASONAL CHANGES & DISTANCE VARIATION from BRIGHT to MUTED
	TEXTURE	MEDIUM to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES and MORE RANDOM TEXTURE on LOWER SLOPES
3. STRUCTURES	FORM	* NONE or NOT EVIDENT *
	LINE	
	COLOR	
	TEXTURE	

(Continued on page 2)

Form 8400-4 (September 1978)
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SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	STEEP ROUNDED FORMS INTERRUPTED BY FLAT, LEVEL PADS
	LINE	REGULAR HORIZONTAL amongst UNDULATING SERIES of RIDGELINES
	COLOR	REDDISH TAN SOIL EXPOSED by CUTS and FILLS
	TEXTURE	FINE, UNIFORM GRAIN
2. VEGETATION	FORM	GEOMETRIC CLEARINGS in fairly UNIFORM SURFACE COVER and PATTERNS (Natural)
	LINE	SHARP, RECTILINEAR and/or UNNATURAL LINE at EDGES of CLEARING
	COLOR	DENUDATION of VEGETATION RESULTS in EXPOSURE of BARE SOIL — REDDISH TAN.
	TEXTURE	FINE - EXPOSED to BARE SOIL
3. STRUCTURES	FORM	VERTICAL, MANMADE forms TENDING TOWARDS DIAGONAL TRACERY. TUBULAR FORMS at WELL HEADS
	LINE	VERTICAL and TRIANGULAR
	COLOR	GREY to RED and/or ORANGE
	TEXTURE	SMOOTH METALLIC

SECTION D. CONTRAST RATING ☐ SHORT TERM ☑ LONG TERM

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	[✓ 12]	8	4	0	12	[✓ 8]	4	0	12	[✓ 8]	4	0
	Line (3x)	9	[✓ 6]	3	0	9	[✓ 6]	3	0	9	[✓ 6]	3	0
	Color (2x)	[✓ 6]	4	2	0	[✓ 6]	4	2	0	[✓ 6]	4	2	0
	Texture (1x)	3	[✓ 2]	1	0	[✓ 3]	2	1	0	3	[✓ 2]	1	0
TOTALS		26				23				20			

1a. Maximum element contrast

CLASS III = MODERATE

b. Maximum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☐ Yes ☒ No *If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.*

Evaluator *(signature)* Jonathan O. Foster

Date 15 DEC 80

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

LANDFORM
1. PADS SHOULD BE LOCATED in AREAS with TENDENCIES TOWARDS FLAT LEVEL TERRAIN to MINIMIZE CUTS and FILLS. AVOID PROMINENT RIDGETOPS
2. ROUND SLOPES on ALL CUTS and FILLS, and BLEND with EXISTING TOPOGRAPHY.

VEGETATION
1. MINIMIZE CLEARING w/ EDGES FEATHERED and IRREGULAR to REDUCE SHARP CONTRASTS.
2. REVEGETATE DISTURBED AREAS with NATIVE PLANTS and USE LOW CONTRAST, DK. COLORED (LANDSCAPE COLORS and TONES for SITE CONDITIONS) MULCHES/EMULSIONS

STRUCTURES.
1. ALL STRUCTURES PAINTED with DULL, NON-REFLECTIVE PAINTS. DARK COLORS SPECIFIED FOR SITE CONDITIONS.
2. LOCATE STRUCTURES BELOW SKYLINE WHERE POSSIBLE.

SECTION F. DESCRIPTION OF ACTIVITY *(Redesigned)*

1. LAND WATER	FORM	FLAT LEVEL PADS with ROUNDED EDGES and SLOPES
	LINE	CONTINUOUS with SLIGHT HORIZONTAL DISRUPTIONS
	COLOR	EXPOSE SOIL. TAN to REDDISH TAN
	TEXTURE	FINE to MEDIUM GRAIN
2. VEGETATION	FORM	IRREGULAR OPENNINGS
	LINE	UNDULATING, IRREGULAR EDGES at CLEAR SOFT EDGE TRANSITION.
	COLOR	TAN to REDDISH TAN with SLOW TENDENC TOWARD GREYISH GREEN on REVEGETATED SLOPES. DK COLORED EMULSION/MULCH.
	TEXTURE	MED to FINE PATCHES in the EXISTING TEXTURE
3. STRUCTURES	FORM	TALL VERTICAL and ANGULAR FORMS. LOCATED BELOW RIDGELINE WHERE POSSIBLE
	LINE	VERTICAL and TRIANGULAR
	COLOR	DK MUTED colors to MEET SITE CONDITIONS (GREYISH GREEN OR BROWNISH GRN) NON-REFLECTIVE
	TEXTURE	FLAT, MATTE

(Continued on page 4)

SECTION G. CONTRAST RATING *(Redesigned)*

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	[✓ 8]	4	0	12	8	[✓ 4]	0	12	[✓ 8]	4	0
	Line (3x)	9	6	[✓ 3]	0	9	6	[✓ 3]	0	9	6	[✓ 3]	0
	Color (2x)	6	4	[✓ 2]	0	6	[✓ 4]	2	0	6	4	[✓ 2]	0
	Texture (1x)	3	2	[✓ 1]	0	3	2	[✓ 1]	0	3	2	[✓ 1]	0
TOTALS		14				12				14			

1a. Maximum element contrast

CLASS III = MODERATE

b. Minimum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☑ Yes ☐ No

If "no," request services of district landscape architect, and describe amount of time and when required.

3. Fiscal year

19

4. Which third? *(check one)*

☐ First ☐ Second ☐ Third

5. TIME REQUIRED

DAYS	MAN-MONTHS

SECTION H. RECOMMENDATIONS

1. Recommendation of staff landscape architect if allowable contrast rating cannot be met

Signature

Date

2. Decision and justification of Area or District Manager

Signature

Date

3. Check appropriate box: ☐ Proceed with project/activity as mitigated ☐ Cancel project/activity as proposed

Signature

Date

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 15 DECEMBER 1980
District UKIAH
Planning unit CLEARLAKE/GEYSERS KGRA
Activity KELSEY·CREEK GEOTHERMAL

SECTION A. PROJECT INFORMATION

1. Project name	2. Critical viewpoint number	3. MFP Step III VRM class
STEAM PIPELINES	TYPICAL	CLASS III

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T 12 N	R 9 W	11, 13, and 14 and 23, 24, 25, and 26	TYPICAL within STUDY AREA

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

1. LAND/WATER	FORM	STEEP ROLLING HILLS DISSECTED BY SHARPLY DEFINED DRAINAGES
	LINE	UNDULATING, IRREGULAR and ROUNDED RIDGELINES at HORIZON APPEARING in SERIES SHARP CONVERGENCE then DRAWN OUT in VALLEYS
	COLOR	SOILS RANGE from TAN to REDDISH TAN · OVERALL BACKGROUND COLOR TENDS to DARK GREYISH GREENS - MUTED COLORS
	TEX-TURE	FINELY GRAINED FOREGROUND BECOMING MODERATE to COARSE in the BACKGROUND where LANDFORMS are MORE IRREGULAR
2. VEGETATION	FORM	MOSTLY ROUNDED or with SLIGHT UNDULATION. CONIFER AREAS SHOW MORE VERTICAL RELIEF with JAGGED/GEOMETRIC FORMS
	LINE	UNDULATING at EDGES of SPECIES MIX and CHANGES OTHERWISE NOT EVIDENT
	COLOR	COLORS RANGE from GREYISH GREEN to YELLOWISH GREENS with SEASONAL CHANGES & DISTANCE VARIATION from BRIGHT to MUTED
	TEX-TURE	MEDIUM to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES and MORE RANDOM TEXTURE on LOWER SLOPES
3. STRUCTURES	FORM	* NONE or NOT EVIDENT *
	LINE	
	COLOR	
	TEX-TURE	

(Continued on page 2)

Form 8400–4 (September 1978)
U.S. Government Printing Office - 78-779-312

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	SLIGHT LINEAR DEPRESSION
	LINE	STRAIGHT: HORIZONTAL, VERTICAL, and/or DIAGONAL
	COLOR	TAN to REDDISH TAN
	TEXTURE	INTERRUPTION SLIGHTLY EVIDENT RESULTING in SMOOTH TEXTURE in LINEAR PATTERN
2. VEGETATION	FORM	INTERRUPTED FORM and PATTERN due to LINEAR LOSS of ROUNDED VEGETATION FORMS
	LINE	INTRODUCED LINEAR PATTERN (STRAIGHT- HORIZ., VERT., and DIAG.) due to VEGETATION LOSS for R.O.W. and FIRE PROTECTION
	COLOR	TAN to REDDISH TAN
	TEXTURE	FINE to SMOOTH GRAIN DISRUPTING EXISTING TEXTURE
3. STRUCTURES	FORM	VERY LINEAR and STRAIGHT · HORIZ., VERT., and DIAGONAL w/ ROUNDED EDGES
	LINE	STRAIGHT, LINEAR REPETITIVE LINES CONSISTENT over LANDSCAPE
	COLOR	GREY
	TEXTURE	SMOOTH METALLIC

SECTION D. CONTRAST RATING ☐ SHORT TERM ☐ LONG TERM

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	8	[✓ 4]	0	12	[✓ 8]	4	0	[✓ 12]	8	4	0
	Line (3x)	9	[✓ 6]	3	0	[✓ 9]	6	3	0	[✓ 9]	6	3	0
	Color (2x)	6	[✓ 4]	2	0	[✓ 6]	4	2	0	[✓ 6]	4	2	0
	Texture (1x)	3	2	[✓ 1]	0	3	[✓ 2]	1	0	3	[✓ 2]	1	0
TOTALS		15				25				29			

1a. Maximum element contrast

CLASS III = MODERATE

b. Maximum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☐ Yes ☐ No *If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.*

Evaluator *(signature)* Jonathan S. Foster

Date 15 DEC 1980

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

LANDFORM: 1. USE EXISTING TOPOGRAPHY as a GUIDE for PIPELINE ALIGNMENT to MINIMIZE CUTS and FILLS, and TO MINIMIZE UNNATURAL LINEAR INTERRUPTIONS.
2. ROUND SLOPES on ALL CUTS and FILLS and BLEND with EXISTING TOPOGRAPHY.

VEGETATION 1. MINIMIZE CLEARING WIDTH as NECESSARY for PIPELINE OPERATION and FUNCTION
2. LEAVE IRREGULAR EDGES ALONG CLEARINGS
3. REVEGETATE ALL DISTURBED AREAS with NATIVE PLANTS.

STRUCTURE 1. CONSOLIDATE WELL HEADS to MINIMIZE NETWORK of PIPELINES.
2. PAINT w/ NON REFLECTIVE PAINTS USING MUTED COLORS as SPECIFIED for SITE CONDITIONS.

SECTION F. DESCRIPTION OF ACTIVITY *(Redesigned)*

1. LAND/WATER	FORM	ROUNDED SLOPES; SLIGHT LINEAR DEPRESSIONS.
	LINE	LINEAR and CURVILINEAR
	COLOR	TAN LINEAR PATTERNS w/ SOFT TRANSITION to GRETISH GREEN
	TEXTURE	SMOOTH LINEAR INTERRUPTIONS
2. VEGETATION	FORM	SMOOTH LINEAR PATTERNS amongst ROUNDED VEGETATION FORMS
	LINE	LINEAR and CURVILINEAR due to CLEARING along PIPELINE
	COLOR	IRREGULAR PATTERNS/LINEAR of TAN/REDDISH TAN along R.O.W.
	TEXTURE	SMOOTH LINEAR OPENNINGS w/ SOFT EDGES amongst MED to COARSE GRAIN
3. STRUCTURES	FORM	LINEAR· HORIZONTAL, VERTICAL, and DIAGONAL CYLINDRICAL FORMS.
	LINE	HORIZONTAL, VERTICAL and DIAGONAL NETWORK
	COLOR	MUTED COLORS to MATCH SITE SPECIFICATIONS USING NON REFLECTIVE PAINTS.
	TEXTURE	FLAT, MATTE FINISH.

(Continued on page 4)

SECTION G. CONTRAST RATING *(Redesigned)*

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	8	4	[✓ 0]	12	8	[✓ 4]	0	12	8	[✓ 4]	0
	Line (3x)	9	[✓ 6]	3	0	9	[✓ 6]	3	0	9	[✓ 6]	3	0
	Color (2x)	6	4	[✓ 2]	0	6	4	[✓ 2]	0	6	4	[✓ 2]	0
	Texture (1x)	3	2	[✓ 1]	0	3	2	[✓ 1]	0	3	2	[✓ 1]	0
TOTALS		9				13				13			

1a. Maximum element contrast

CLASS III = MODERATE

b. Minimum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☒ Yes ☐ No

If "no," request services of district landscape architect, and describe amount of time and when required.

3. Fiscal year

19

4. Which third? *(check one)*

☐ First ☐ Second ☐ Third

5. TIME REQUIRED

DAYS	MAN-MONTHS

SECTION H. RECOMMENDATIONS

1. Recommendation of staff landscape architect if allowable contrast rating cannot be met

Signature

Date

2. Decision and justification of Area or District Manager

Signature

Date

3. Check appropriate box: ☐ Proceed with project/activity as mitigated ☐ Cancel project/activity as proposed

Signature

Date

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 15 DECEMBER 1980

District: UKIAH

Planning unit: CLEARLAKE/GEYSERS KGRA

Activity: KELSEY·CREEK GEOTHERMAL

SECTION A. PROJECT INFORMATION

1. Project name GENERATING PLANT	2. Critical viewpoint number TYPICAL	3. MFP Step III VRM class CLASS III

4a. LOCATION

TOWNSHIP	RANGE	SECTION
T12N	R9W	11, 13, and 14 and 23, 24, 25 and 26

b. LOCATION MAP

TYPICAL within STUDY AREA

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

1. LAND WATER	FORM	STEEP ROLLING HILLS DISSECTED BY SHARPLY DEFINED DRAINAGES
	LINE	UNDULATING, IRREGULAR and ROUNDED RIDGELINES at HORIZON APPEARING in SERIES. SHARP CONVERGENCE then DRAWN OUT in VALLEYS
	COLOR	SOILS RANGE from TAN to REDDISH TAN. OVERALL BACKGROUND COLOR TENDS to DARK GREYISH GREENS - MUTED COLORS
	TEXTURE	FINELY GRAINED FOREGROUND BECOMING MODERATE to COARSE in the BACKGROUND where LANDFORMS are MORE IRREGULAR
2. VEGETATION	FORM	MOSTLY ROUNDED or with SLIGHT UNDULATION. CONIFER AREAS SHOW MORE VERTICAL RELIEF with JAGGED/GEOMETRIC FORMS
	LINE	UNDULATING at EDGES of SPECIES MIX and CHANGES OTHERWISE NOT EVIDENT
	COLOR	COLORS RANGE from GREYISH GREEN to YELLOWISH GREENS with SEASONAL CHANGES & DISTANCE VARIATION from BRIGHT to MUTED
	TEXTURE	MEDIUM to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES and MORE RANDOM TEXTURE on LOWER SLOPES
3. STRUCTURES	FORM	* NONE or NOT EVIDENT *
	LINE	
	COLOR	
	TEXTURE	

(Continued on page 2)

SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER

FORM: FLATTENED to LEVEL PAD with ANGULAR FORMS at CUTS and FILLS

LINE: RECTILINEAR and ANGULAR · DISCONTINUOUS

COLOR: TAN to REDDISH TAN

TEXTURE: FINE GRAINED to UNEVEN and COARSE

2. VEGETATION

FORM: INTERRUPTED PATTERN and LOSS of NATURAL VEG. FORMS

LINE: HORIZONTAL DISRUPTIONS

COLOR: TAN to REDDISH TAN (SOIL EXPOSED DUE to VEG. LOSS)

TEXTURE: INTERRUPTED to FINE and UNEVEN TEXTURE

3. STRUCTURES

FORM: LONG RECTILINEAR FORMS w/ CYLINDRICAL TOWERS

LINE: RECTILINEAR w/ PROMINENT HORIZONTALS and PARABOLIC VERTICALS

COLOR: GREY to WHITE

TEXTURE: SMOOTH to METALLIC

SECTION D. CONTRAST RATING ☐ SHORT TERM ☑ LONG TERM

DEGREE OF CONTRAST	FEATURES											
	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
ELEMENTS	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
Form (4x)	[✓ 12]	8	4	0	12	[✓ 8]	4	0	[✓ 12]	8	4	0
Line (3x)	9	[✓ 6]	3	0	9	[✓ 6]	3	0	[✓ 9]	6	3	0
Color (2x)	[✓ 6]	4	2	0	[✓ 6]	4	2	0	[✓ 6]	4	2	0
Texture (1x)	3	[✓ 2]	1	0	3	[✓ 2]	1	0	3	[✓ 2]	1	0
TOTALS	2				22				29			

1a. Maximum element contrast

CLASS III = MODERATE

b. Maximum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☐ Yes ☑ No *If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.*

Evaluator (*signature*) Jonathan S. Foster

Date 15 DEC 1980

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

LANDFORM 1. RESTRICT EARTHWORK to MINIMUM NECESSARY for SITING of GENERATING FACILITY. NO MAJOR CUTS and FILLS.
2. ROUND SLOPES on ALL CUTS and FILLS, and BLEND with EXISTING TOPOGRAPHY.
3. USE BERMS to HELP REDUCE APPARENT SCALE of POWER PLANT

VEGETATION 1. KEEP CLEARING to MINIMUM and LEAVE IRREGULAR EDGES.
2. REVEGETATE ALL DISTURBED AREAS with NATIVE PLANTS and REPLANT to COMPLIMENT NATURAL VEG. PATTERNS.

STRUCTURES 1. NO STRUCTURE SHALL BREAK the SKYLINE above RIDGE TOPS. STRUCTURES SHOULD HAVE BACKDROP of LANDSCAPE.
2. STRUCTURES WILL BE ARRANGED in COMPACT CONFIGURATION
3. COLORS CHOSEN TO BLEND with SITE CONDITIONS. NON REFLECTIVE
4. REDUCE HEIGHT of ALL STRUCTURES

SECTION F. DESCRIPTION OF ACTIVITY *(Redesigned)*

1. LAND/WATER	FORM	FLATTENED to ROUNDED
	LINE	HORIZONTAL, BLENDING with EXISTING TOPOGRAPHY with NO ABRUPT TRANSITIONS.
	COLOR	TAN to REDDISH TAN PATCHES in GREYISH GREEN COVER.
	TEXTURE	FAIRLY UNIFORM with PATCHES of SMOOTH TEXTURE at EXCAVATED AREAS.
2. VEGETATION	FORM	INTERRUPTED PATTERN
	LINE	IRREGULAR EDGES at CLEARINGS; SOFT EDGE TRANSITIONS BETWEEN EXISTING VEGETATION and CLEARINGS & REVEG. AREAS.
	COLOR	GREY GREENS with PATCHES of TAN to REDDISH TANS
	TEXTURE	UNEVEN; SMOOTH, FINE GRAINED AREAS INTERSPERSED in MORE MODERATE to COARSE TEXTURED AREAS
3. STRUCTURES	FORM	LOW, RECTILINEAR, BLOCK FORMS w/ CYLINDRICAL TOWERS
	LINE	HORIZONTAL w/ PROMINENT PARABOLIC VERTICALS
	COLOR	MUTED, DARK TONES THAT BLEND with LOCAL SITE CONDITIONS. NON REFLECTIVE PAINT
	TEXTURE	FLAT, MATTE

(Continued on page 4)

SECTION G. CONTRAST RATING *(Redesigned)*

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	[✓ 8]	4	0	12	8	[✓ 4]	0	12	[✓ 8]	4	0
	Line (3x)	9	6	[✓ 3]	0	9	6	[✓ 3]	0	9	6	[✓ 3]	0
	Color (2x)	6	4	[✓ 2]	0	6	[✓ 4]	2	0	6	4	[✓ 2]	0
	Texture (1x)	3	2	[✓ 1]	0	3	2	[✓ 1]	0	3	2	[✓ 1]	0
TOTALS		14				12				14			

1a. Maximum element contrast

CLASS III = MODERATE

b. Minimum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☑ Yes ☐ No

If "no," request services of district landscape architect, and describe amount of time and when required.

3. Fiscal year

19

4. Which third? *(check one)*

☐ First ☐ Second ☐ Third

5. TIME REQUIRED

DAYS	MAN-MONTHS

SECTION H. RECOMMENDATIONS

1. Recommendation of staff landscape architect if allowable contrast rating cannot be met

Signature

Date

2. Decision and justification of Area or District Manager

Signature

Date

3. Check appropriate box: ☐ Proceed with project/activity as mitigated ☐ Cancel project/activity as proposed

Signature

Date

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 15 DECEMBER 1980

District UKIAH

Planning unit CLEARLAKE/GEYSERS KERA

Activity KELSEY·CREEK GEOTHERMAL

SECTION A. PROJECT INFORMATION

1. Project name TRANSMISSION LINES	2. Critical viewpoint number TYPICAL	3. MFP Step III VRM class CLASS III

4a. LOCATION			b. LOCATION MAP
TOWNSHIP	RANGE	SECTION	
T12 N	R9W	11, 13, and 14 And 23, 24, 25, and 26	TYPICAL within STUDY AREA

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

1. LAND/WATER	FORM	STEEP ROLLING HILLS DISSECTED BY SHARPLY DEFINED DRAINAGES
	LINE	UNDULATING, IRREGULAR and ROUNDED RIDGELINES at HORIZON APPEARING in SERIES. SHARP CONVERGENCE then DRAWN OUT in VALLEYS.
	COLOR	SOILS RANGE from TAN to REDDISH TAN. OVERALL BACKGROUND COLOR TENDS to DARK GREYISH GREENS - MUTED COLORS
	TEXTURE	FINELY GRAINED FOREGROUND BECOMING MODERATE to COARSE in the BACKGROUND where LANDFORMS are MORE IRREGULAR
2. VEGETATION	FORM	MOSTLY ROUNDED or with SLIGHT UNDULATION. CONIFER AREAS SHOW MORE VERTICAL RELIEF with JAGGED/GEOMETRIC FORMS
	LINE	UNDULATING at EDGES of SPECIES MIX and CHANGES OTHERWISE NOT EVIDENT
	COLOR	COLORS RANGE from GREYISH GREEN to YELLOWISH GREENS with SEASONAL CHANGES & DISTANCE VARIATION from BRIGHT to MUTED
	TEXTURE	MEDIUM to COARSE GRAIN with EVEN TEXTURE on UPPER SLOPES and MORE RANDOM TEXTURE on LOWER SLOPES
3. STRUCTURES	FORM	* NONE or NOT EVIDENT *
	LINE	
	COLOR	
	TEXTURE	

(Continued on page 2)

Form 8400–4 (September 1978)
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SECTION C. PROPOSED ACTIVITY DESCRIPTION

(Refer to BLM Manual Section 8131 for proposed descriptions and requirements)

1. LAND/WATER	FORM	SLIGHT LINEAR DEPRESSION
	LINE	UNNATURAL LINEAR R.O.W for CORRIDOR
	COLOR	DISRUPTION of GREYISH, GREEN due to DENUDATION of VEGETATION EXPOSING BARE SOIL at TOWERS and ALONG R.O.W.
	TEX-TURE	INTERRUPTION SLIGHTY EVIDENT RESULTING in SMOOTH TEXTURE in LINEAR PATTERN.
2. VEGETATION	FORM	ROUNDED FORMS LOST in CORRIDOR RESULTING in FLAT or SMOOTH FORM along CORRIDOR
	LINE	INTRODUCED LINEAR PATTERN of VEGETATION LOSS along CORRIDOR
	COLOR	LOSS of GREYISH to YELLOWISH GREEN RESULTING in BARE SOIL of TAN to REDDISH COLOR
	TEX-TURE	DISRUPTION of EXISTING TEXTURE w/ SMOOTH or FINE GRAIN
3. STRUCTURES	FORM	ANGULAR, OPEN FABRICATION, STEEL TOWERS at REGULAR INTERVALS
	LINE	TALL, VERTICAL TRACERY w/ FAINT, SAGGING WIRE LINKAGE
	COLOR	GREY
	TEX-TURE	SMOOTH METALLIC

SECTION D. CONTRAST RATING ☐ SHORT TERM ☒ LONG TERM

DEGREE OF CONTRAST		FEATURES											
		LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
		Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
ELEMENTS	Form (4x)	12	8	[✓ 4]	0	12	8	[✓ 4]	0	12	[✓ 8]	4	0
	Line (3x)	9	6	[✓ 3]	0	9	[✓ 6]	3	0	9	[✓ 6]	3	0
	Color (2x)	6	[✓ 4]	2	0	6	[✓ 4]	2	0	[✓ 6]	4	2	0
	Texture (1x)	3	2	[✓ 1]	0	3	[✓ 2]	1	0	3	2	[✓ 1]	0
TOTALS		12				16				21			

1a. Maximum element contrast

CLASS III = MODERATE

b. Maximum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☐ Yes ☑ No *If "no," (or if rating is over maximum allowable) redesign project in section E, concentrating on feature/element of greatest contrast. If contrast is acceptable, this does not prelude additional mitigating measures; propose as stipulations, and list in section E.*

Evaluator *(signature)* Jonathan S. Fesler

Date 15 DEC 80

SECTION E. REDESIGN, STIPULATIONS, MITIGATING MEASURES

LANDFORM 1. USE EXISTING TOPOGRAPHY for LEAST VISIBLE CORRIDOR and as BACKDROP for STRUCTURES. DO NOT SKY LINE any TRANSMISSION TOWERS
2. MINIMIZE CUTS and FILLS
3. IF ACCESS ROADS NEEDED FOLLOW "ROADS" STIPULATIONS

VEGETATION 1. MINIMIZE CLEARING and LEAVE NATURAL EDGES and PATTERNS.
2. REVEGETATE DISTURBED AREAS ING NATIVE PLANT MATERIALS

STRUCTURES 1. USE LATTICE TYPE TOWERS where FEASIBLE
2. PAINT w/ DULL NON-REFLECTIVE COLORS COMPATIBLE w/ LANDSCAPE COLORS and TONES

SECTION F. DESCRIPTION OF ACTIVITY *(Redesigned)*

1. LAND/WATER	FORM	SLIGHT LINEAR DEPRESSION
	LINE	SLIGHT INTERRUPTED or INTRODUCED LINES. DISCONTINUOUS in APPEARANCE
	COLOR	GREYISH GREEN w/ SPOTS of TAN to REDDISH TAN
	TEXTURE	SLIGTH INTERRUPTION of SMOOTH FINE GRAINED AREAS
2. VEGETATION	FORM	SPOTS of FLAT SMOOTH AREAS amongst ROUNDED FORMS
	LINE	IRREGULAR, SOFT EDGED LINE at CLEARINGS
	COLOR	GREYISH GREEN with PATCHES of TAN to REDDISH TAN
	TEXTURE	FAIRLY UNIFORM of SOME DISRUPTION at CLEARINGS
3. STRUCTURES	FORM	VERTICAL and ANGULAR w/ OPEN TRACERY LOCATED BELOW SKYLINE
	LINE	TALL VERTICAL TRACERY w/ SLIGHT SAGGING WIRES
	COLOR	DARK MUTED COLORS COMPATIBLE w/ LANDSCAPE NON REFLECTIVE; DULL PAINTS
	TEXTURE	FLAT, MATTE SURFACE non REFLECTIVE

(Continued on page 4)

SECTION G. CONTRAST RATING *(Redesigned)*

DEGREE OF CONTRAST	FEATURES											
	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
ELEMENTS	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)	Strong (3x)	Moderate (2x)	Weak (1x)	None (0x)
Form (4x)	12	8	4	[✓ 0]	12	8	4	[✓ 0]	12	8	[✓ 4]	0
Line (3x)	9	6	[✓ 3]	0	9	6	[✓ 3]	0	9	6	[✓ 3]	0
Color (2x)	6	4	[✓ 2]	0	6	4	[✓ 2]	0	6	4	[✓ 2]	0
Texture (1x)	3	2	[✓ 1]	0	3	2	[✓ 1]	0	3	2	[✓ 1]	0
TOTALS	6				6				10			

1a. Maximum element contrast

CLASS III = MODERATE

b. Minimum feature contrast

CLASS III = 16

2. Does project design meet visual resource management requirements? ☑ Yes ☐ No

If "no," request services of district landscape architect, and describe amount of time and when required.

3. Fiscal year

19

4. Which third? *(check one)*

☐ First ☐ Second ☐ Third

5. TIME REQUIRED

DAYS	MAN-MONTHS

SECTION H. RECOMMENDATIONS

1. Recommendation of staff landscape architect if allowable contrast rating cannot be met

Signature

Date

2. Decision and justification of Area or District Manager

Signature

Date

3. Check appropriate box: ☐ Proceed with project/activity as mitigated ☐ Cancel project/activity as proposed

Signature

Date

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